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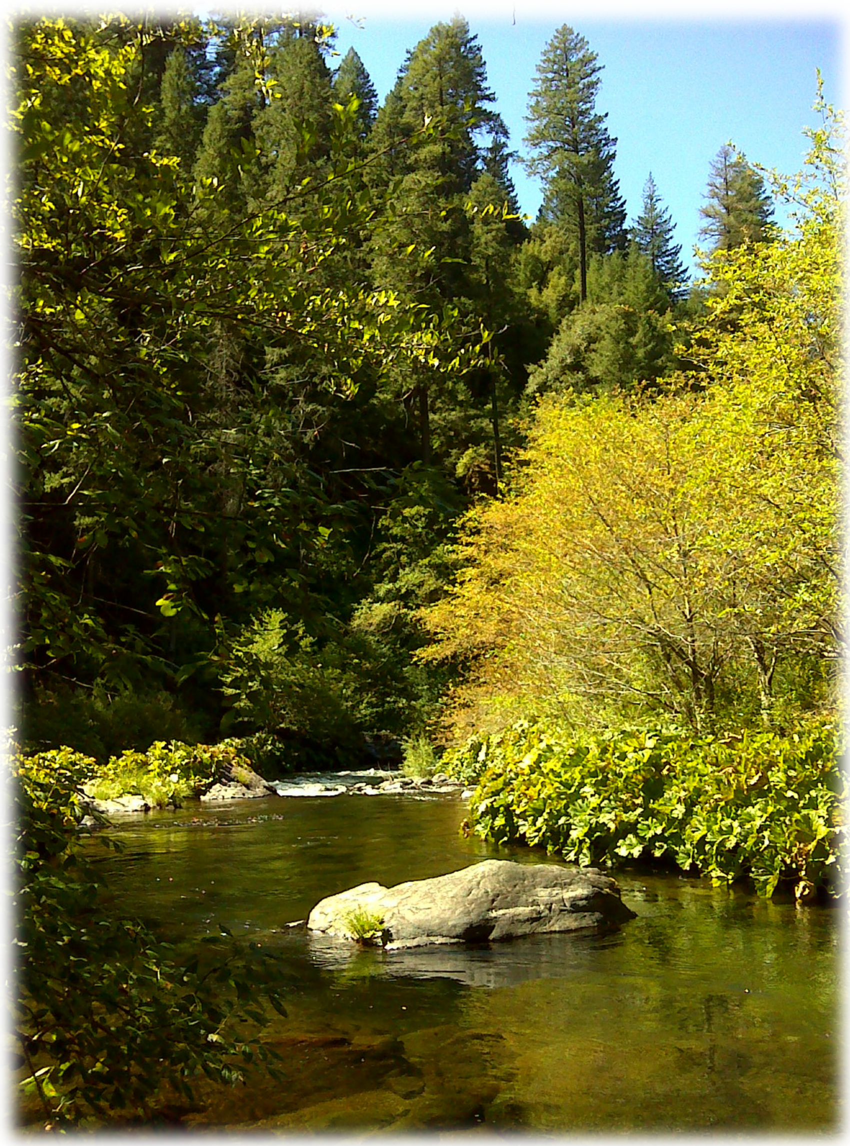
Squaw Valley Creek Watershed Analysis

Shasta-McCloud Management Unit
Shasta-Trinity National Forest



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Introduction

About This Analysis

This watershed analysis is presented as part of the Aquatic Conservation Strategy adopted for the President's "Northwest Forest Plan" (Record of Decision [ROD] for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, including Standards and Guidelines for Management of Habitat for late-successional and Old-Growth Related Species; USDA Forest Service and USDI Bureau of Land Management 1994).

The preparation of a watershed analysis for the Squaw Valley Creek watershed follows direction in the Aquatic Conservation Strategy that requires watershed analysis "for roadless areas in non-key watersheds, and Riparian Reserves prior to determining how land management activities meet Aquatic Conservation Strategy objectives" (ROD, p. B-20).

This document is guided by two levels of analysis:

- Core topics - provide a broad, comprehensive understanding of the watershed.

Core topics which address basic ecological conditions, processes, and interactions at work in the watershed are provided in "Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis", Version 2.2 (Regional Interagency Executive Committee and the Intergovernmental Advisory Committee 1995).

- Issues - focus the analysis on the main management questions to be addressed.

Issues are those resource problems, concerns, or other factors upon which the analysis will be focused. Some of these issues prompted initiation of the analysis. Other issues were developed from public input in response to scoping or were identified by the team during the analysis process.

Key analysis questions are developed for each issue. These questions are organized by analysis steps to help focus the analysis and to provide organization to the document while addressing the issues.

This document represents an analysis of the Squaw Valley Creek Watershed (primarily the Mt. Shasta – Lower McCloud Squaw Valley Creek Sub-watershed) located primarily within the McCloud River Management Area (#10) of the Shasta-Trinity National Forest (see Map 1 – Vicinity). The analysis area encompasses approximately 37,586 acres (59 square miles). Of the total acres in the analysis area, approximately 27,377 acres (77 percent) are National Forest land, and the remaining 8,209 acres (23 percent) are private landholdings. The Squaw Valley Creek Watershed was selected for analysis to enable the Forest Service to plan long-term management of the watershed.

The purpose of this analysis is to provide district resource managers with a scientifically based understanding of the ecological processes and interactions occurring within the watershed area and how past and present activities and events interact with the physical, biological, and social environments. Although the information from this assessment can be used as a basis from which to make future decisions regarding the management of resources in the Squaw Valley Creek Watershed it should be noted that this is not a decision document.

The Analysis Process

This analysis used the six-step process as outlined in the Federal Guide for Watershed Analysis. The six-step process includes the following:

- **Step 1: Characterization** – identifies the dominant physical, biological and human processes or features of the watershed that affect ecosystem function and conditions.
- **Step 2: Identification of Resource Issues and Key Questions** – focuses the analysis on the key elements of the ecosystem that are most relevant to the management objectives, human values or resource conditions within the watershed.
- **Step 3: Description of Current Conditions** – documents the current range, distribution and condition of the relevant ecosystem elements.
- **Step 4: Description of Reference Conditions** – documents how ecological conditions have changed over time as a result of human influence and natural disturbances.
- **Step 5: Synthesis and Interpretation of Information** – compares existing and reference conditions of specific ecosystem elements to explain significant differences, similarities or trends and their causes.
- **Step 6: Recommendations** – brings the results of the previous steps to conclusion, focusing on management recommendations that are responsive to watershed processes identified in the analysis.

The analysis also evaluates conditions in the Squaw Valley Creek Watershed as they relate to conditions at larger scales such as the McCloud River Watershed. This analysis also discusses the importance of unique geological and biological features within the watershed with regard to paleontological records and rare flora and fauna on the west coast of the United States.

Watershed analysis is a continuous process. This document is dynamic and, as such, is intended to be revised and updated as new information becomes available.

Chapter 1: Characterization of the Watershed

The purpose of this chapter is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The relationship between these ecosystem elements and those occurring in the river basin or province is established. This chapter provides the watershed context for identifying elements that need to be addressed in the analysis.

The major topics covered in this chapter are:

- Location
- Watershed Setting
- Relationship to Larger-Scale Settings
- Physical, Biological and Human Features
- Land Allocations and Management Direction

Location

The Squaw Valley Creek Watershed Analysis area is bounded by Girard Ridge to the west, Bald Mountain ridgeline to the east, and by Dogwood Butte to the north. The southernmost boundary forms the confluence with the larger McCloud River Basin, as Squaw Valley Creek converges with the McCloud River.

Watershed Setting

The Squaw Valley Creek Watershed is sub-divided into two Sub-watershed units. The Squaw Valley Creek Watershed Analysis area is specific to the downstream Mt. Shasta-Lower Squaw Valley Creek Sub-watershed. This document, however, also addresses features outside of the immediate geographical area that have influence on the processes and qualities described within the analysis area. The named HUC 7 drainages: Pig Creek, Dairy Creek, Willow Creek, Cabin Creek, Trough Creek, Tom Neal Creek and Tom Dow Creek are included within the Squaw Valley Creek Watershed analysis area (see Map 2 – Hydrologic Units).

The majority of the watershed analysis area is managed by the Shasta-Trinity National Forest (NF). Most of the land that is not part of the Shasta-Trinity NF is in the northern portion of the analysis area. Other inclusions of private and state lands occur on the eastern portion of Girard Ridge, areas adjacent to approximately 1.5 miles of downstream Squaw Valley Creek, and over 1,500 acres of land within the Tom Dow Creek-McCloud River drainage (see Map 3 – Land Ownership).

Relationship to Larger Scale Setting

Many physical, biological and human processes or features span areas much larger than a watershed. To appropriately characterize and analyze specific aspects of the watershed, the watershed needs to be placed in its logical setting with respect to these larger scales.

Five larger-scale settings need to be considered when addressing the Squaw Valley Creek Watershed analysis area:

- The Upper Sacramento Basin

- The McCloud Sub-basin
- The Squaw Valley Creek Watershed
- The West Girard Inventoried Roadless Area
- The Iron Canyon Late-Successional Reserve RC-335 (LSR)

See the Land Allocations and Management Direction discussion for specific information regarding the West Girard Inventoried Roadless area as well as the Iron Canyon LSR.

Upper Sacramento Basin

The Upper Sacramento Basin drains an area of approximately 3,900 square miles. It is located north of the Keswick Dam, and includes several rivers such as the Pit River, McCloud River, and the Little or Upper Sacramento Rivers above Shasta Lake.

McCloud Subbasin

The McCloud Subbasin drains an area of roughly 680 square miles. Its headwaters are at Colby Meadows near the town of Bartle. The McCloud river flows southwesterly for approximately 50 miles to its terminus at Shasta Lake (see Map 4 – McCloud Subbasin and USDA Forest Service 1998).

Physical conditions and land use patterns in the McCloud Subbasin are best described by dividing the Subbasin into three sections:

1. The Upper McCloud River (above McCloud Reservoir)
    - Terrain is generally flat to gentle slopes and includes the McCloud Flats.
    - Vegetation consists of mixed-conifer and ponderosa pine forest.
    - Land use is predominantly timber management and grazing with recreation use concentrated along the river.
2. The Lower McCloud River (between McCloud Reservoir and Shasta Lake)
    - Terrain consists of a deep canyon through which the river flows.
    - Vegetation is predominantly mixed-conifer and Douglas-fir forest. A large area west of the McCloud River is dominated by hardwoods and chaparral vegetation.
    - Timber management has occurred in the Hawkins Creek drainage and the upper slopes on the southeast side of the river.
3. The McCloud Arm of Shasta Lake
    - Terrain consists of a deep canyon through which the river flows. However, this section of the river has been inundated by Shasta Lake.
    - Vegetation is predominantly montane hardwood, montane hardwood-conifer, and Sierran mixed-conifer.
    - High density recreation use occurs on the lake and its shoreline. Much of the remaining area is rugged, inaccessible, and essentially unroaded.

The Squaw Valley Creek Watershed

Squaw Valley Creek flows into the McCloud River within the Lower McCloud River Watershed and encompasses an area of approximately 104 square miles. The Lower McCloud River tributaries, including Squaw Valley Creek, supply over three times more runoff to the McCloud River than is supplied by the entire Upper McCloud River Watershed (USDA Forest Service 1998). The headwaters of Squaw Valley Creek Watershed begin on the southern slopes of Mount Shasta and travel south to the confluence with the McCloud River.

Physical Features

The United States Geological Survey developed a hierarchical system for defining ordered watersheds. A set of commonly used terms describe relative geographic areas. These areas are referred to as a Hydrologic Unit Code (HUC) and used with a series 2 digit numeric descriptor refer to the order within the hierarchy. A Watershed is synonymous with a HUC5 or 5th field HUC. See Table 1. The procedure for subdividing a subbasin into a collection of watersheds is highly debated. Regardless of the process used, subdivision of a subbasin yields two categories of watersheds: (1) true watersheds in which all water flows to a common point and (2) areas formed as residuals or byproducts of delineating true watersheds. These residual areas may be referred to as composite watersheds, interfluvial areas, or facial areas. Both categories, being roughly the same size, fit within the watershed level of the geographic size hierarchy. This nomenclature is used throughout this analysis to refer to these hydrologic units (Table 1).

Table 1. Hydrologic Nomenclature.

Hierarchy Term	HUC Label/Code	Example
Region	18	California Region
Subregion	1802	Sacramento
River Basin	18020000	Upper Sacramento
Subbasin	18020004	McCloud
Watershed	1802000403	Squaw Valley Creek
Subwatershed	180200040302	Mount Shasta-Lower Squaw Valley Creek*
Drainage	18020004030205	Tom Dow Creek-McCloud River

*Denotes the Squaw Valley Creek Watershed Analysis area

Geological Uniqueness

The Squaw Valley Creek Watershed is unique in that it straddles the boundary between the Cascades and Klamath Mountains physiographic provinces, and its headwaters are on the flanks of Mt Shasta, one of the largest volcanoes in the Pacific Northwest. The presence of large meadows along Squaw Valley Creek near the transition from the Cascades to the Klamath Mountains province may be related to the differences in groundwater flow through these distinct rock types. The Klamath Mountains portion of the watershed consists of metamorphosed andesite, rhyolite and tuff, along with metamorphosed sediments such as chert, quartzite and marble. The marble is referred to as the “McCloud Limestone”, and it occurs in the lower reaches of the watershed. Though it comprises slightly more than 1% of the Squaw Valley Creek watershed area, it is a very important rock unit because of its effect on subsurface hydrology, it’s propensity to form caves, and the plant communities it supports. The McCloud Limestone is displayed on Map 5 - Bedrock, and Map 6 – Limestone Bearing Map Units, which display all rock units possibly containing limestone. Relative to similar nearby steep mountainous watersheds in this part of the Shasta-Trinity National Forest, there are very few historic landslides and debris flows in Squaw Valley Creek.

In summary, the geological uniqueness of the Squaw Valley Creek Watershed is due to the following characteristics:

1. The analysis area spans the transition between the Cascade and Klamath Mountains Physiographic Provinces;
2. The headwaters are situated on flanks of Mount Shasta;
3. Marble outcrops and karst terrain are present in the middle and lower reaches of the analysis area;
4. The analysis area has experienced relatively few historic landslides and debris flows

Dominant Physical Features

The dominant features within the analysis area include Squaw Valley Creek Canyon, Squaw Valley, and the mountain ridges that define the watershed. In a broader context, features within the McCloud sub-basin include the town and greater community of McCloud, as well as Mount Shasta. Squaw Valley Creek flows into McCloud River, and eventually Shasta Lake. Dominant features within the watershed are shown on Map 7 – Dominant Physical Features.

Climate

Annual average precipitation in the Squaw Valley Creek analysis area ranges from 55 to 80+ inches. Precipitation occurs predominantly from November through March. Precipitation is likely to occur as snow or rain-on-snow during the wet season. Isolated thunderstorms are common within the area during summer months and may produce localized precipitation, primarily as rain. Precipitation amounts fall dramatically as temperatures increase during spring, summer, and early fall. Summer temperatures vary within the analysis area due to varied microclimates, but are generally warm with noticeable fluctuations.

Geology, Geomorphology, and Erosion Processes

Geologic and Geomorphic Setting

Bedrock and Structure

The headwaters of Squaw Valley Creek are occupied predominantly by volcanic rocks of the High Cascades and, to a lesser degree, those of the Western Cascades. The High Cascades are younger (less than 6 million years old), and include pyroclastic flows, lava flows and volcanic ash. The Western Cascade rocks range from about 30 million to 6 million years in age, and also consist of lava flows and ash deposits. They are usually more weathered than the High Cascades. Unpublished mapping by Robert L. Christiansen (US Geological Survey 2000) reveals that glacial moraines occupy much of the headwaters of Squaw Valley Creek from 6200 to 8,000 feet in elevation, between Red Fir Ridge and Red Butte. Pyroclastic deposits are present in the uppermost parts of the watershed, and debris flow deposits, most of which are older than 10,000 years, occupy most of the site of McCloud, California, and extend more than a mile to the south. Downstream from the debris flow deposits, the valley of Squaw Valley Creek is occupied by wide alluvial deposits which are less than 10,000 years old, and extend for several miles south into the Klamath Mountains Province. From the outcrop pattern, it looks as if andesite lavas from Everett Hill may underlie these alluvial deposits. This suggests that lavas from Mt Shasta filled a pre-existing valley floor. This notion is supported by the small outcrop of high Cascades andesite which occurs near the junction of Connor Creek with Squaw Valley Creek within a large meadow. Several photolineaments were identified during air photo review conducted for this analysis. Photolineaments are linear breaks in the topography which can be seen on air photos, and sometimes on topographic maps, and shaded relief maps. They often coincide with faults or regional fracture systems. Two of these traverse the landscape parallel to Trough and Beartrap Creeks.

Geomorphic Processes

The Squaw Valley Creek Watershed can be subdivided into three distinct geomorphic process zones; a) the steep headwaters on the flanks of Mount Shasta which are primarily outside the analysis area; b) the relatively gentle transition zone between the Cascades and Klamath Mountains which contains large meadows within the valley floor; and c) the steep, dissected mountainous lands which occupy the lower two thirds of the watershed, and are entirely within the Klamath Mountains Province. Geomorphic processes are very different in each of these three areas. On the flanks of Mount Shasta slopes are steep, the young volcanic rocks are very porous, and annual precipitation is very high - and is dominated by snow. Snow avalanches, rock fall, debris slides, and debris flows occur in this setting. In the transition zone between the Cascades and Klamath Mountains, slopes are relatively gentle, erosion is dominated by fluvial processes and surface soil erosion, and landsliding is rare. In the lower reaches of the watershed, slopes are very steep (see Map 8 – Percent Slope), and hillslopes are deeply dissected. In this setting, mass wasting dominates the erosional processes, primarily through debris slides and debris flows. Debris slides are shallow, rapidly moving landslides, and debris flows are sediment-laden slurries which travel rapidly through stream channels and scour the steeper reaches and deposit sediment in gentler reaches. These processes produce a variety of landforms, including steep headwall basins, debris slide scars, and inner gorges, which are evident on the geomorphic map (Map 9 - Geomorphology). Despite these landforms, the watershed has experienced only a small number of debris slides and debris flows in the past 60 year. This is a very low frequency relative to similar, nearby watersheds. The Forest geomorphic gis data (active features) identifies only a few isolated recently active debris slides (see Map 9) such as on the SE flank of Yellowjacket Mountain. Deep seated landslides such as slumps, earthflows, and block slides are relatively rare in the watershed, and comprise a small percentage of the area (Table 3).

Karst Processes

Karst processes operate in the areas underlain by marble and include chemical solution of calcium carbonate by slightly acidic groundwater. Groundwater chemistry is influenced by organic material in the soil and ash produced from fire. This chemical process results in open joints and caves in the bedrock (which is highly permeable) and allows for rapid movement of groundwater. This can lead to situations where rainwater falling in one watershed can be transported across a topographic divide to a separate watershed through the subsurface via the permeable rock. There are anecdotal accounts of such a situation in the Tom Dow and Dutch Creek watersheds. Marble outcrops often have very little soil cover, and precipitation infiltrates rapidly through openings in the rock without the filtering effects of the soil. As a result, any polluting agents on the surface can be transported directly into the groundwater. Collapse of subsurface voids in karst terrain can result in subsidence of the land surface. Caves form unique ecosystems and often contain paleontological and cultural resources. Fossils can include Quaternary vertebrates which may have utilized the cave, or Paleozoic invertebrates within the marble itself. The Forest has no data on the locations of the caves in the analysis area, but many have been described by the caving community. In order to protect and manage these caves, the Forest will need to determine their locations.

Volcanic Processes

Due to the proximity to Mount Shasta, Squaw Valley Creek would be subject to the effects of future eruptions and other volcanic processes. Eruptions have occurred at a frequency of a few hundred years, with the most recent being in the late 1700's. The US Geological Survey is currently reassessing volcanic hazards around Mount Shasta in order to better define the recurrence interval of eruptions, and results should be available in 3-5 years. Eruption of fluid lava often forms lava tube caves, but there are no known lava tube caves within the analysis area.

Groundwater

Though studies were initiated recently to better define the groundwater system as part of a spring water development proposal, the information being collected and analyzed is currently not available to the Forest Service (see hydrology section). As a result the groundwater system and its interactions with the surface drainage system are not well understood, and a detailed map of all known spring locations and information on flow characteristics is not readily available. In light of the absence of this information, the following generalized model is offered to describe the groundwater situation. Precipitation in the headwaters of the watershed likely infiltrates rapidly into the porous young volcanic rock of the High Cascades, and travels quickly through fractures down to the interface with the older and more weathered rocks of the Western Cascades and the Klamath Mountains. The Western Cascades rocks are generally less permeable than the High Cascades rocks (Mack 1960), but some of the lavas in the Western Cascades are likely as permeable as those in the High Cascades. The Klamath Mountains rocks are generally much less permeable than either of the Cascade units, with the exception of the areas underlain by marble, which is typically very permeable. With this model in mind, water percolating through the High Cascade rocks would come into contact with the less permeable underlying Klamath Mountains rocks, and emerge at the surface as springs. An example of this would be where a lava flow had been deposited on top of a soil developed on weathered metamorphic rocks of the Klamath Mountains. The buried soil and weathered rock would be less permeable than the lava flow, and groundwater would travel along the interface, and then emerge at the surface where the base of the lava flow was exposed by erosion. Due to the lack of data, the concepts presented above should be viewed only as possible interpretations of the system. These interpretations could be tested with field investigations to see if there is a relationship between springs and these rock contacts. Another feature which may be influencing the groundwater system is the presence of faults and regional fracture systems in the bedrock. As mentioned above, photolineaments coincide with Trough and Beartrap Creeks. Such features are often associated with fracture zones in the bedrock, and can influence groundwater flow.

Geomorphic Processes and Land Use

Several land uses can affect erosional processes in the analysis area including (in decreasing order of magnitude) roads, timber harvest, mechanized fire suppression, trails, and prescribed fire. Fire suppression in a fire-dependent ecosystem has multiple interrelated effects, such as increased potential for large high severity fires due to decades of fire suppression. Karst processes are influenced by groundwater chemistry, which in turn are affected by vegetation and organic material in the soil. Fire and its products (ash, smoke) are natural components of the ecosystem, and caves have evolved with these components. As a result, prescribed fire would not be a new or different factor in the ecosystem, provided it occurred within the range of effects and timing associated with natural fire. Smoke from fire can enter caves and temporarily affect air quality. Fire retardant applied aerially could be introduced into the groundwater if applied in karst areas, and this could affect water chemistry. A study of these effects was conducted recently by the US Park Service at Sequoia National Park. Initial findings were that the effects of retardant on water chemistry and invertebrates were minimal in that example (Tobin et al. 2009). However, a final report addressing the extrapolation of these findings to other areas is not yet available.

Geomorphic Hazards and Resources

Geologic hazards within the Squaw Valley Creek watershed include landslides, rock fall, debris flows, flooding, volcanic and seismic hazards, and karst subsidence. Primary geologic resources include groundwater, paleontological resources. Additionally, barite is present, and has been mined in the past (refer to hydrologic report). There may also be mining-related hazards in the vicinity of abandoned barite mines, but this potential has not been evaluated.

Caves harbor unique ecosystems with particular management needs and are protected by the Federal Cave Resource Protection Act of 1988. This law (and associated Code of Federal Regulations) promotes protection and conservation of cave resources, and cooperation between Federal Agencies and the caving community, including organizations such as the National Speleological Society. Caves are known to exist in the project area within the McCloud Limestone, but the Forest has no data on the location or nature of these caves (Brad Rust, personal communication 2011). The Forest has a Memorandum of Understanding (MOU) with the Shasta Area Grotto, and cooperates regularly with this group in the conservation of cave resources. An MOU between the US Forest Service and the National Speleological Society is also in place.

Fossils are protected by the Paleontological Resources Preservation Act of 2009 (Omnibus Public Lands Management Act of 2009). This law requires the Secretaries of the Interior and Agriculture to manage and protect paleontological resources on Federal land using scientific principles and expertise. The new law affirms the authority for many of the policies the Federal land managing agencies already have in place for the management of paleontological resources such as issuing permits for collecting paleontological resources, curation of paleontological resources, and confidentiality of locality data. Actual fossil localities may exist within the project area, but at present, they are presently unknown to the Forest Service.

Soils

Soils in the Squaw Valley Creek Watershed are divided north and south by a change in topography. Gently sloping, deep or very deep, well drained soils formed in volcanic alluvium occupy the northern portion of the watershed. Steeply sloping, well drained, moderately deep or shallow soils formed from metasedimetary parent material dominate the southern portion of the watershed analysis area. On the stream terraces adjacent to Squaw Valley Creek, are areas of poorly drained soils. Overall, the soils tend to be only moderately developed but there are occasional occurrences of more developed soils exhibiting translocated clay in the subsoil. The entire watershed is in the mesic temperature regime and the xeric moisture regime.

Surface erosion is closely tied to slope. Generally, on the sideslopes which exceed 50 percent, the erosion hazard is severe to very severe on bare mineral soil (i.e. without vegetative cover). The erosion process is continual but more likely to occur in areas laid bare of vegetation due to management, wildfire, or mass wasting. The ridgetops and colluvial toeslopes exhibit gentler slopes than the sideslopes and therefore the erosion hazard is only moderate. The nearly level stream terraces in the northern end of the watershed have only a slight erosion hazard (see Map 10 – Soils).

Hydrology

Squaw Valley Creek is the dominant hydrologic feature within the analysis area. Squaw Valley Creek is free flowing and unregulated. The analysis area focuses on the Mt. Shasta-Lower Squaw Valley Creek Sub-watershed (Hydrologic Unit Code (HUC) 6). The hydrology in this section is described in the context of the entire Squaw Valley Creek Watershed due to the area's unique features as well as the influence of the terrain and groundwater movement exert on the analysis area. The Squaw Valley Creek Watershed runs from north to south and the catchment area is notably elongated. Three distinct geomorphic areas occur within the Squaw Valley Creek Watershed. The northern (upper) portion of the watershed begins high on the southern slopes of Mount Shasta and extends down to the community of McCloud. The terrain changes significantly in the geographic middle of the watershed, exhibiting moderately steep slopes. The southern-most portion of the watershed is characterized by steep slopes with steep inner gorges (see Map 8). The hydrology and hydraulics within these three sections are dramatically influenced by varied geomorphology.

On the slopes of Mount Shasta, the volcanic rocks of the High Cascades serve as an intake area and storage reservoir for ground water. Most of Mt. Shasta is mantled with thin, rocky soils that overlie highly fractured volcanic rocks. The soils and fractured rocks absorb large quantities of water derived from rain and snow. Glacial melt supplies water to the mountain's streams, but even this stream water infiltrates the porous volcanic rocks of the High Cascades, and stream flows diminish downstream (USDI Geological Survey 1988). Squaw Valley Creek receives flow from several springs both upstream and downstream from the town of McCloud. The majority of known springs within the Squaw Valley Creek Watershed are upstream of the analysis area. Squaw Valley Creek is one of four streams originating on Mount Shasta that have sufficient surface flow to reach downstream channels. The headwaters of Squaw Valley Creek are located between Red Fir Ridge and Sargents Ridge in the Thimbleberry Drainage.

The Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek Drainages are located in the geographic middle of the Squaw Valley Creek Watershed. These drainages have the most moderately-sloped terrain in the Squaw Valley Creek Watershed and are predominantly privately owned. Approximately 783 acres of National Forest System (NFS) lands occur in the Willow Creek-Squaw Valley Creek Drainage.

The Tom Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek Drainages comprise the southern-most and downstream portion of Squaw Valley Creek Watershed. Within these drainages, 79 percent of area has slopes greater than 35 percent. Four of the 28 springs currently mapped within Squaw Valley Creek Watershed are located in these drainages and many more springs are known to exist.

No perennial lakes occur within the analysis area; however, a very large (several-acre) potential vernal pool called Dry Lake is located in Trough Creek Drainage.

Stream Channel

Stream channel morphology in the analysis area is dominated by natural geomorphic and fluvial processes, as well as human activities which have varied influences in the drainages. Channel morphologies are varied within the analysis area due to differences in land formations.

Squaw Valley Creek has been studied for eligibility for Wild and Scenic River status. The lower 10.5 mile section of Squaw Valley Creek from the Cabin Creek confluence to the terminus at McCloud River was determined eligible for this status. This 10.5-mile stretch of stream was found to have Outstandingly Remarkable Values (ORV) for both native trout fisheries and scenery. A Coordinated Resource Management Plan (CRMP) was adopted for Squaw Valley Creek in lieu of recommendation for Wild and Scenic River status (see Maps 11 and 12 – CRMP). Two contiguous segments of Squaw Valley Creek were identified. The northern segment was found to be eligible as 'Scenic', and the downstream reach was found to be eligible as 'Wild'. See the Shasta-Trinity Wild & Scenic Rivers report for the complete analysis. Should the requirements of the CRMP not be fulfilled, the Forest Service reserves the right to pursue Wild and Scenic River status for the lower section of Squaw Valley Creek (USDA Forest Service 1994).

Stream channels in the Squaw Valley Creek Watershed are broadly classified as follows:

- **Upland channels (swales, colluvial or bedrock channels)**
    - source areas for in-stream sediment
    - most vulnerable to land-use impacts due to abundance and steep topography
    - most of these channels have not been influenced by land-use impacts on federal lands
    - the impact of land use on these channels on private land is largely unknown
- **Cascade channels**
    - generally exhibit perennial flows
    - steep and dominated by boulder substrates
    - sediment transported through cascade channels during peak flows
    - larger order streams in Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek Drainages
- **Step-pool channels**
    - lower gradients than cascade channels
    - characterized by a pattern of alternating steps and pools
    - waterfalls often occur where bedrock is exposed
    - sediment delivery from upland channels can result in aggradation of smaller, low-gradient step-pool channels
- **Pool-riffle or plane-bed channels**
    - upper reaches of Squaw Valley Creek within analysis area

The morphology of channels and the unstable slopes associated with them may be affected by fire suppression, catastrophic fire and prescribed fire. Effective fire suppression over the past several decades has allowed vegetation and fuels to accumulate in the watershed. Increased vegetation cover and a decrease in the fire return interval may be affecting erosion processes and sediment delivery to the channel network.

Water Quality

The quality of water in the analysis area is influenced by both natural processes and land-use activities. Beneficial uses dependent on high quality water include: fish and aquatic life (including riparian vegetation), domestic and municipal water supply, industrial and agricultural supply, hydropower generation, water contact and non-contact recreation; aesthetic enjoyment, freshwater habitat, fish spawning, wildlife habitat, and preservation or enhancement of fish, wildlife and other aquatic resources.

The community of McCloud depends on springs as their major source of water supply. The water for the town of McCloud is supplied by Intake Springs within the Squaw Valley Creek Watershed (see Map 2).

Water quality is generally assumed to meet water quality regulations. No 303d impaired areas (Clean Water Act and 40 CFR §130.7) are currently identified in the analysis area.

Biological Features

Vegetation

Forest Vegetation

Vegetation in the Squaw Valley Creek Watershed consists of predominantly conifer stands intermixed with a small proportion of hardwoods, as well as typical vegetation expected for a montane region in the Klamath Mountains (see Map 13 – Vegetation Aerial Imagery). Approximately 94 percent of the land base is in forest vegetative cover, with the remaining land base mostly comprised of chaparral, grassland, and meadow areas. There is a small portion that is classified as Urban, accounting for less than one percent of the land base.

Forest vegetation in the Squaw Valley Creek Watershed is distributed within the following three categories:

- hardwoods – 5 percent
- mixed hardwood/conifer – 11 percent
- conifer – 78 percent

Hardwood stands are predominantly comprised of oak species and often contain scattered gray pine (*Pinus sabiniana*) and other conifers. Conifer stands are mainly composed of ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga meziesii*), white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*) and black oak (*Quercus kelloggii*). There is a small component of closed-cone pines (*Pinus attenuata*) that accounts for less than 1 percent of the conifer dominated stands. Mixed stands are transitional between these two and contain varying proportions of hardwoods and conifers (see Map 14 – Vegetation).

The majority of forest stands (approximately 78 percent) are dense, with crown canopy of 60 percent cover or more. Most forest stands (approximately 36 percent) have an average overstory tree diameter of 15 to 23 inches, measured as diameter at breast height (d.b.h.). Roughly fifty percent of the watershed consists of late-successional conifer stands. These older conifer stands occur mostly in the upper reaches of the watershed on north- to east-facing slopes. There are approximately 320 acres of plantations in the watershed dating from 1983-1997.

Riparian vegetation is well developed along perennial streams. Important riparian components include umbrella plant (*Darmera peltata*), willow (*Salix* sp.), bigleaf maple (*Acer macrophyllum),* torrent sedge (*Carex nudata*), white alder (*Alnus rhombifolia*), and western azalea (*Rhododendron occidentale*), and Himalayan blackberry).

Other Vegetation

Chaparral vegetation occurs on approximately 3 percent of the watershed and is characterized by a diversity of flowering shrubs (manzanita and California lilac species) and by shrub-sized hardwoods (e.g. Brewer oak). Grasslands in the watershed are small and are intermingled with oak woodlands; species composition is dominated by invasive annual grasses introduced from the Mediterranean region in the northern portion of the analysis area, and by native perennial grasses and wildflowers in the southern portion of the analysis area. Wet meadows are also present, primarily in the northern portion of the analysis area, and are comprised of sedges, rushes, grasses, wildflowers, and scattered willow clumps.

Fire and Fuels

Fire has played a major role in shaping vegetation composition and structure in the watershed analysis area (Taylor and Skinner 1998, Skinner et al. 2006, Agee 2007). The analysis area extends through the lower- to mid-montane ecological zones and is historically characterized by frequent fires of low- to-mixed severity (Taylor and Skinner 1998, Skinner et al. 2006). Lightning, European settlers, and American Indian-ignited fires were the primary factors shaping the vegetation, creating primarily multi-aged stands (Taylor and Skinner 1998).

Stand and vegetation structures, along with severity patterns within this regime, are highly dependent on the complex combination of topography, vegetation composition, and climate (Skinner et al. 2006, Agee 2007). Generally, upper slope positions and south- and west-facing slopes burn at higher frequencies and with higher severities than lower slope positions and north- and east-facing slopes (Weatherspoon and Skinner 1995, Taylor and Skinner 1998, Jimerson and Jones 2003, Skinner et al. 2006). Spatial variation in soil productivity, in conjunction with steep gradients of elevations and aspects, controls the rates of fuel accumulation (Skinner et al. 2006). Disturbance history affects the fuel profile and is linked to patterns of fire severity on the landscape (Alexander et al. 2006, Miller et al. 2009).

In 1924 there was a fire of approximately 3,643 acres in the southern portion of the watershed which is likely to have caused some of the area to be deforested. This fire was followed by more than 80 years of fire suppression which allowed for vegetation development and fuels accumulation. There are three other documented fires of note in the watershed, the Scooter fire in 1988 that burned 147 acres and resulted from equipment use, the Squaw fire in 1991 that burned 158 acres and was caused by smoking, and the Girard fire in 2003 that was only 12 acres and was caused by lightning. These recent fires were immediately suppressed.

As mentioned previously, the climate of the analysis area is best described as Mediterranean, characterized by wet, cool winters and dry, warm summers (Skinner 2006). Mean annual precipitation ranges from 55 to 80+ inches in the watershed and primarily occurs from November through March. Summer thunderstorms are common, and can release significant amounts of localized rain. These storms can also be dry with conditions that encourage fire ignition and spread from lightning strikes, with the summer of 2008 being the latest example of this pattern near the analysis area when a significant number of lightning strikes from a dry thunderstorm event ignited numerous fires throughout northern California.

The steep and complex landscape creates a unique interaction with fire weather and elevation during the hot, dry summers when high pressure prevails and smoke does not dissipate which often results in temperature inversions. While these inversions can lead to benign fire behavior, they can also create public health issues and concerns over high densities of smoke particulates that cover large areas and can persist for many days. When the temperature inversions are broken by high winds, fire behavior can increase significantly, resulting in large areas of high-severity fire.

Numerous fire starts still occur in the watershed analysis area. With the onset of fire suppression in the early 1900s and increased effectiveness of suppressing fires with mechanized equipment (fire engines, dozers, aircraft, etc.) in recent years, most of the fires are kept small. This has been primarily achieved through the use of aerially delivered firefighters and the use of retardant during initial attack. Since the year 1924, there has been no individual fire over 200 acres in this watershed (see Map 15 – Fire History by Decade). As a result, forest vegetation has changed from a heterogeneous pattern to a more homogeneous pattern of smaller openings in a matrix of denser forest (Skinner et al. 2006). Therefore, one of the most extensive problems related to the health of this watershed is the over-accumulation of vegetation and fuel loading due to a lack of disturbance from fire. Although severity patterns are still largely dependent on physical factors (e.g., slope position, aspect, slope percentage, elevation, etc.), the current vegetation composition and structure has created conditions that increase the likelihood of larger areas of intense and severe fire (Scott and Reinhardt 2001, Taylor and Skinner 2003, Skinner et al. 2006).

Species and Habitat

Threatened, Endangered and Sensitive (TES) Plants and Other Species of Concern

Management direction for rare vascular and nonvascular plants and fungi on the Shasta-Trinity NF is found in the Land and Resource Management Plan (LRMP) primarily on pages 4-14 through 4-16. These species may include federally listed Threatened or Endangered species, Sensitive and Endemic species, watch list species, and Survey and Manage species (USDA Forest Service and USDI Bureau of Land Management 2001). Endangered and Threatened species are those listed under the Endangered Species Act of 1973. Sensitive species are those not meeting federal criteria but are listed by the Regional Forester. Forest Endemic species are those found only on the STNF and are afforded the same protection as Sensitive species. Survey and Manage species are those designated by the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 2001). Watch list plant species are listed by the California Native Plant Society (CNPS) as rare but do not meet the criteria for federal or Forest listing. These watch list plants are usually of sufficient local viability concern, however, to be considered in planning processes.

According to the Land and Resource Management Plan (LRMP p. 4-5), Forest goals for botanical species include the following:

- "Monitor and protect habitat for federally listed threatened and endangered (T&E) and candidate species. Assist in recovery efforts for T&E species. Cooperate with the State to meet objectives for State-listed species."

- "Manage habitat for sensitive plants...in a manner that will prevent any species from becoming a candidate for T&E status."

No Threatened or Endangered plants are known or suspected to occur on the Forest. Refer to the project file for a complete list of TES, Survey and Manage, and other special status vascular plant, bryophyte, lichen and fungus species of concern on the Shasta-Trinity NF.

The following Sensitive, Endemic, or Survey and Manage plant species are either documented occurrences or likely to occur in the Squaw Valley Creek Watershed. The analysis watershed is within the geographic range of the species and is classified as suitable habitat.

- Shasta eupatory (*Ageratina shastensis*)
- scabrid alpine tarplant (*Anisocarpus scabridus)*
- veiny arnica (*Arnica venosa*)
- Shasta clarkia (*Clarkia borealis* ssp. *borealis)*
- mountain lady's slipper (*Cypripedium montanum)*
- Butte County fritillary (*Fritillaria eastwoodiae)*
- Shasta snow-wreath (*Neviusia cliftonii)*
- Pacific fuzzwort (*Ptilidium californicum)*
- English Peak greenbriar (*Smilax jamesii*)

There are additional CNPS watch list species occurring or having habitat within the watershed. Their listing, common name and scientific name follow:

List 2.2 (rare, threatened, or endangered in CA; common elsewhere)

- Aleppo avens (*Geum aleppicum)*

List 2.3 (rare, threatened, or endangered in CA; common elsewhere)

- marbled wild ginger (*Asarum marmoratum)*
- slender sedge (*Carex lasiocarpa)*,

List 3.2 (review list)

- Howell's lewisia (*Lewisia cotyledon* var. *howellii)*

List 4.2 (limited distribution)

- Baker's wild hollyhock (*Iliamna bakeri*)
- Oettinger's trillium (*Trillium ovatum* ssp. *oettingeri*)

List 4.3 (limited distribution)

- Shasta beardtongue (*Penstemon heterodoxus* var. *shastensis)*

While these species are not listed by the USDA Forest Service Pacific Southwest Region 5 (Region 5) as sensitive, the Forest Service documents occurrences identified during botanical surveys on National Forest lands and designs project activities to reduce or avoid impacts to documented populations.

Noxious and Undesirable Weed Species

The Forest Service Manual (FSM) directs National Forests to "Determine the factors which favor the establishment and spread of noxious weeds and design management practices or prescriptions to reduce the risk of infestation or spread of noxious weeds" (FSM 2081.2). The following selected noxious weed species are of high concern in or near the watershed. Refer to the project file for a complete list of invasive plants on the STNF.

The following noxious weed species have documented occurrences in the Squaw Valley Creek Watershed Analysis area.

- Italian plumeless thistle (*Carduus pycnocephalus*)
- yellow star thistle (*Centaurea solstitialis*)
- bull thistle (*Cirsium vulgare*)
- houndstongue (*Cynoglossum officinale*)
- St. John's wort (*Hypericum perforatum*)
- perennial pea (*Lathyrus latifolius*)
- black locust (*Robinia pseudoacacia*)
- Himalayan blackberry (*Rubus armeniacus*)
- cutleaf blackberry (*Rubus laciniatus*)
- Spanish broom (*Spartium junceum*)

The following noxious weed species have documented occurrences within five miles of the Squaw Valley Creek Watershed Analysis area.

- tree of heaven (*Ailanthus altissima*)
- nodding plumeless thistle (*Carduus nutans*)
- spotted knapweed (*Centaurea maculosa*)
- Canada thistle (*Cirsium arvense*)
- Scotch broom (*Cytisus scoparius*)
- Dyer's woad (*Isatis tinctoria*)
- American pokeweed (*Phytolacca americana*)

Terrestrial Wildlife Species and Habitat

Habitat for terrestrial wildlife species associated with early-, mid- and late-seral mixed-conifer forest occurs within the Squaw Valley Creek Watershed, though the majority (approximately 82 percent) of the watershed, inclusive of private land, contains only mid to late-successional mixed conifer habitat. Within this are large contiguous blocks of older, high quality late-successional habitat that have the potential to support multiple Forest Service Sensitive and federally listed wildlife species, such as the northern spotted owl (see Map 16 – Late Successional Conifer Habitat).

In addition to late-successional, mixed conifer forest, there are a variety of other vegetative habitats including montane hardwood, oak woodland, annual and perennial grassland, and riparian corridors. Other terrestrial wildlife habitat includes limestone outcroppings and caves, though these habitats are a small percentage of the overall watershed. All of these habitats combined total approximately 18 percent of the watershed. Management of these habitat types, as described in the LRMP, involves a mix of protection, avoidance, or minimal treatment.

The watershed is made up of several land allocations whose objectives shape the overall management goals for the area, but two main allocations play a large part in the management of the species and habitats in the area: Late-Successional Reserve (LSR) and Riparian Reserve (see Map 17 – Late Successional Reserve and Roadless Area and Map 18 – Riparian Reserves). Within the 22,824 acre Late-Successional Reserve (Iron Canyon LSR#335) portion of the watershed (approximately 36 square miles) are 7,397 acres (11.5 square miles total) of Riparian Reserves. Management of LSRs involves specific actions designed to improve, promote, and protect late-successional habitat, as described in the Shasta-Trinity LRMP:

> *"Late-Successional Reserves are to be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem" (LRMP pp. 4-63, 4-70).*

Within the Shasta-Trinity National Forest-wide Late Successional Reserve Assessment (LSRA; US Forest Service 1999), the amount of late-successional forest currently available in the LSRs, relative to each LSR, was measured as an indicator of how well the LSR was providing for late-successional associated species. LSR-335 was identified as having 25,010 acres of late-successional habitat and 47,546 acres of mid successional habitat, out of a total 76,409 acres of capable lands.

Management within Riparian Reserves is designed to maintain and restore aquatic systems, species composition, and water quality, in addition to late-successional habitats that may be present in the Reserve, as described in the Shasta-Trinity LRMP:

> *"Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted" (LRMP pp. 4-53).*

Because of this overarching goal for management of the watershed, benefits are imparted to the species associated with late-successional habitats such as the northern spotted owl, northern goshawk, marten, fisher, as well as multiple species of mollusk, bat and amphibian.

In addition to the late-successional habitat, limestone slopes and outcroppings are also present in the watershed and contain suitable habitat for bat species, several terrestrial mollusks species, peregrine falcons and the Shasta salamander (see species list below and Map 6).

Limestone areas do not require specific management actions in order to improve, promote, or protect the habitat, other than surveys that identify areas to be flagged and avoided during management actions that would cause disturbance through habitat modification and/or ground disturbance.

Caves are also present within the watershed. The LRMP describes a cave as "any naturally occurring void, cavity, recess, or system of interconnected passages which occur beneath the surface of the earth or within a cliff or ledge … and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made", with guidelines for the management described as:

> *"Provide additional protection for caves, mines, and abandoned wooden bridges and buildings that are used as roost sites for bats" (LRMP p. 4-53).*

Multiple species are associated with caves within the Squaw Valley Creek Watershed potentially including 15 species of bat, three of which are Forest Service Sensitive species, and the remaining five listed in the LRMP Environmental Impact Statement (EIS) as species of interest (see list below).

Wildlife species of special concern or interest in the Squaw Valley Creek Watershed are divided into five main categories for the purpose of this analysis. A complete list is included in Chapter 3.

- Federally Listed Species
- Forest Service Sensitive Species
- Survey and Manage Species
- Game Species
- Neotropical Migratory Birds

The Squaw Valley Creek Watershed, in combination with the Lower McCloud watershed, represents the most south-central contiguous block of late-successional habitat available for connectivity for species dependent on mature forest types as described under the Northwest Forest Plan planning area. This watershed is part of a larger landscape of habitat which enables movement of old growth species from further north into the Sierra Nevada mountain range to the southeast and the Klamath Mountains to the southwest. In addition, it is one of largest watersheds to not have had a major, stand replacing fire event over a significant portion of the forested area (Henery 2008). This watershed is also distinctive, in that it contains a large portion of the late-successional habitat found in the Iron Canyon LSR RC-335 (see discussion on below on LSRs).

Species of special concern or interest with recorded locations within the watershed include northern goshawk, Pacific fisher, several bat species, a variety of terrestrial mollusks, willow flycatcher, northwestern pond turtle, foothill yellow-legged frog, Shasta salamander, bald eagle, wild turkey, blue grouse, black bear, Pileated woodpecker and a variety of owl species including the northern spotted owl (CNDDB 2011). Many other species of interest have suitable habitat and the potential for occupancy in the watershed (see discussion in Chapter 3). There are two sightings recorded in the watershed for California wolverine on Nature Conservancy lands (Hesseldenz 2011 personal communication), though neither sighting can be confirmed.

Designated Critical Habitat

Critical Habitat for the northern spotted owl (federally Threatened status) occurs within the Squaw Valley Creek Watershed. Critical Habitat is a legal designation identified under the Endangered Species Act, having been designated on January 15, 1992 (57 FR 1796). Revised Critical Habitat was designated on August 13, 2008. Within the Squaw Valley Creek Watershed, the areas overlap each other for the most part, though acreages between the two designations are somewhat different.

Under the 1992 designation the unit is referred to as Critical Habitat Unit (CHU) CA-4. CHU CA-4 encompasses 100 percent of the federal lands within the watershed. CHU CA-4 comprises 23,096 acres (approximately 36 square miles), or 62 percent, of the watershed as a whole. The total size of the 1992 designated CHU CA-4equals 88,958 acres, with approximately 26 percent of it (2,329 acres) located inside the analysis boundary (See Map 19 - Northern Spotted Owl Critical Habitat Unit).

Within the 2008 Critical Habitat designation, the unit is referred to as CHU-28, and comprises 75 percent of the federal lands within the watershed analysis area. CHU-28 comprises 17, 233 acres (approximately 27 square miles), or 46 percent, of the watershed analysis area as a whole, inclusive of private land. The total size of the 2008 designated CHU-28 is 110,755 acres (approximately 172 square miles), with approximately 16 percent of it (17,233 acres) is located inside the analysis boundary (See Map 19 – Northern Spotted Owl Critical Habitat Unit).

Aquatic and Riparian-dependent Species and Habitats

The construction of Shasta Dam and subsequent creation of Shasta Lake had a major impact on the surrounding natural aquatic and riparian environment. The dam eliminated the anadromous fishery resource in the Pit, McCloud, and Upper Sacramento Rivers and their tributaries, blocking salmon and steelhead (*Oncorhynchus mykiss*) access to habitat they historically occupied in Squaw Valley Creek.

Aquatic habitats in the watershed analysis area are dominated by perennial, cool water streams with adequate instream cover, deep pool habitats formed by bedrock, boulders and large woody debris; and dense riparian vegetation. Mainstem Squaw Valley Creek has fairly constant year-round flows fed by cold water from Mount Shasta snow melt, natural fresh-water spring sources, and numerous tributaries. Squaw Valley Creek and its tributaries support a variety of aquatic and riparian species including resident and non-native trout and other fish species, freshwater mollusks and other invertebrates, amphibians and reptiles.

Stream habitats are dominated by fluvial populations of native rainbow trout and introduced populations of brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*) (see Map 20 – Stream Types and Fish Presence). The trout fishery provides popular angling opportunities for recreationists. Other native fish species include Sacramento sucker (*Catostomus occidentalis*) and riffle sculpin (*Cottus gulosus*). Fathead minnow (*Pimephales promelas*) have also been introduced into the watershed (Moyle 2002). Lake-run rainbow (*Oncorhynchus mykiss*) and brown trout from Shasta Reservoir use the lower reaches of Squaw Valley Creek for spawning along with rainbow trout and brown trout from the McCloud River. Kokanee salmon (*Oncorhynchus nerka*) may have also utilized the lower reaches as they were introduced into the McCloud River; however, they were not found in Squaw Valley Creek during surveys in the mid 1980s (Hesseldenz 2011 personal communication). In summer months the availability of aquatic habitat may be reduced in some tributary streams due to low flows but dissolved oxygen levels and water temperatures generally remain cool to support the fishery.

Human Uses

Human use within the Squaw Valley Creek Watershed is limited compared to that of other watersheds in the area. The Squaw Valley Creek Watershed is remotely located and contains few roads or trails. Only one main route, the Squaw Valley Road off of Highway 89, provides passenger-car access into and within the watershed. Other roads within the watershed are mainly jeep trails and are often off-limits for public access. Additionally, there are a few hiking trails present in the watershed, including the Pacific Crest Trail (PCT) and Squaw Valley Creek Trail (see Map 21 – Recreation). Use of the PCT is relatively infrequent but the Squaw Valley Creek Trail receives a considerable amount of use.

Approximately 39 percent of the Squaw Valley Creek Watershed is privately owned, with the remaining 61percent in public (Forest Service) ownership. Many private properties in the Squaw Valley Creek region were deeded via land grants pursuant to the Pacific Railway Act of 1864 (13 Stat. 356). Private ownership activities or designations include nature preserves, fishing clubs, a utility company, timber companies, and ranching. Several of these private landowners, as well as other key stakeholders within the watershed, participate in a program established through the Coordinated Resource Management Plan (CRMP) developed in 1991. This plan establishes guidelines to coordinate management activities with principle landowners in the McCloud River Drainage area and public agencies that administer programs in that area (McCloud River CRMP 1991).

The public lands within the watershed have unique designations relating to human use. Ninety-nine percent of the public acreage is contained within a Late-Successional Reserve (LSR), 51 percent is considered Inventoried Roadless, and 32 percent is designated as Riparian Reserve (see Maps 17 and 18). One of the management objectives within LSRs is to protect and enhance conditions of late-successional forest ecosystems by reducing the risk of large-scale disturbance, which includes major human caused impacts (USDA Forest Service 1999). The roadless designation clearly limits vehicle access by preventing the creation of new roads within these allocated portions of the watershed except under specific circumstances. Riparian Reserves have standards and guidelines which limit programmed timber harvest, and manage roads, grazing, mining and recreation to achieve objectives of the Aquatic Conservation Strategy (USDA Forest Service and USDI Bureau of Land Management 1994). See the Land Management and Allocations discussions for further information.

Heritage Resources

Native Americans had occupied the Squaw Valley Creek Watershed prior to European contact, and the watershed lies within the aboriginal territory of the Winnemem Wintu (Wintu). The Wintu are not a federally recognized tribe and do not have treaty rights, although they are currently pursuing federal recognition. They are consulted under various federal laws that require consultation with traditional native people (NHPA, ARPA, etc.). The Winnenmem Wintu have expressed interest in re-establishing salmon in the McCloud River (High Country News 2010, New York Times 2010, Winnemem Wintu 2011), which would affect salmon numbers in the Lower McCloud and Squaw Valley Creek watersheds.

Within the Squaw Valley Creek Watershed, there are a total of 24 currently mapped heritage resource sites, most of which are located directly adjacent to water. There are nine prehistoric sites, four multi-component (both historic and pre-historic) sites, nine historic sites, and two historic trails. Six of these sites (three prehistoric, one historic, and two multi-component sites) are located on private property belonging to the McCloud River Club. The rest of the sites are located on National Forest land.

Recreation Resources

Management direction for recreation resources on the Shasta-Trinity NF is found in the Land and Resource Management Plan (LRMP) on pages 4-23 and 4-24, the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994), as well as the CRMP.

According to the Land and Resource Management Plan (LRMP p. 4-5), Forest goals for recreation include the following:

- "Manage the Shasta-Trinity National Forest land base and resources to provide a variety of high quality outdoor recreation experiences."
- "Increase emphasis on areas of national significance such as…the Wild and Scenic Rivers System".
- "Encourage use of the Forests by the disadvantaged, physically challenged, and minorities".

Due to its remote location, the Squaw Valley Creek Watershed offers recreationists opportunities for isolated or "out-of-the-way" outdoor experiences in a low-elevation heavily-forested canyon setting. Recreational activities within the watershed primarily include whitewater boating, wildlife viewing, hunting, hiking, camping, and fishing. See the Current Conditions section for detailed information on these activities.

Transportation System and OHV Routes

As noted previously, roads into and within the Squaw Valley Creek Watershed are limited. There are approximately 147 miles of private and NFS roads in the watershed, mainly in the northern portion, resulting in a density of approximately 2.5 miles of road per square mile of land (see Map 22 – Transportation). Most roads are jeep trails and were originally constructed for access to private land and for recreational opportunities. Both authorized and unauthorized (not on designated trails) off-highway vehicle (OHV) use has occurred in the watershed.

Although a low road density provides access challenges for recreationists wishing to enter the watershed, it has an associated beneficial effect of providing non-motorized recreation areas for those seeking this type of outdoor experience. The limited number of roads in the watershed may also pose management issues regarding access for implementing planned treatments (e.g. timber harvest) or unplanned events (e.g. wildland fire). See the Vegetation and Fire and Fuels sections for further discussion.

Visual Resources and Scenery

The visual quality of the Squaw Valley Creek Watershed is generally high within the analysis area, particularly on public lands. Vegetation is generally free of fire-scarring due to an absence of large scale fires within the recent past. Late seral forest is abundant as are limestone outcrops and other geologic features of note. Timber harvesting on public lands has not been significant in this watershed, and thus has had little impact on visual quality. The allocation of 22,824 acres to a Late-Successional Reserve also continues to minimize the amount of potential timber harvest; particularly in the southern half of the watershed.

A central visual draw for many recreationists is the river environment which has "unique and outstandingly remarkable features" (LRMP p. 4-121). The LRMP describes visual quality objectives (VQOs) for each management prescription to enhance scenic quality on the Forest (see Chapter 3). Additionally, broader scale VQO examples (e.g. roads and high use areas would be managed to protect the scenery within the foreground) are defined on page 2-6 in the LRMP.

Fire and Fuels as Related to Human Uses

Increased vegetation densities and fuel loading over time have led to concerns over fire behavior within and adjacent to the wildland-urban interface as well as fire effects to other resources such as recreation (see Map 23 – Wildland Urban Interface). Prescribed burning often produces smoke management issues that may decrease recreational use within the watershed. Large-scale unplanned fire events may have a larger impact to recreation as these events often occur during summer months when recreation use is typically at its highest. Air quality issues as well as the closure of roads and trails for safety concerns may also restrict recreation opportunities during and immediately following implementation of prescribed fire.

Human presence and influence in the watershed may lead to an increase in the risk of undesirable human-ignited fires. Activities at the bottom of slopes tend to pose the highest threat for large scale human-caused fires; as the fire travels upslope in the direction of the prevailing winds. For this watershed the prevailing winds are generally from the north, but winds originating from the south-southwest associated with a cold front passage can provide conditions for large fire growth. See the Fire and Fuels discussion in this watershed analysis for a detailed discussion of fire behavior and characteristics.

Land Allocations and Designations

Land Ownership

The Squaw Valley Creek Watershed encompasses approximately 37,586 acres. Of the total acres in the watershed, approximately 27,377 acres (77 percent) are National Forest land, and the remaining 8,209 acres (23 percent) are private landholdings.

There are numerous key stakeholders within the watershed, whose ownerships comprise a large portion of the private holdings within the watershed. Those stakeholders include private timber companies (e.g. Sierra Pacific Industries, Roseburg Forest Products), John Hancock Insurance (manage as timberlands), The Nature Conservancy, the Hearst Corporation, Willow Creek Ranch and the McCloud River Club. There are also other numerous private landowners with smaller parcels of property located mainly in the northern portion of the watershed.

Land Management Plan Land Designations

Management direction for the Squaw Valley Creek Watershed is found in the Shasta-Trinity National Forests Land and Resource Management Plan (LRMP). The LRMP incorporates direction from the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994).

Map 3 in Appendix C displays both public and private ownership within the Squaw Valley Creek Watershed Analysis area. Map 24 in Appendix C displays the land allocations within National Forest System lands in the analysis area, as designated in the Shasta-Trinity NF LRMP. Map 25 and Map 16 in Appendix C display the management areas and prescriptions for National Forest System lands in the analysis area, as described in the LRMP.

Late-Successional Reserve (LSR)

Approximately 22,824 acres (61 percent) of the watershed analysis area is designated as a late-successional reserve (LSR). The Iron Canyon LSR encompasses approximately 87,674 total acres, 26 percent of which is located in the Squaw Valley Creek Watershed. The LSR accounts for approximately 99 percent of federal ownership in the watershed (see Map 17). Objectives for late-successional reserves as described in the LRMP are as follows:

"Late-Successional reserves are to be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl. These reserves are designed to

maintain a functional, interacting, late-successional and old-growth forest ecosystem." (LRMP pp. 4-63, 4-70).

This land allocation contains a single management prescription category, with the following objectives:

Management Prescription VII – Late-Successional Reserves and Threatened, Endangered and Selected Sensitive Species: The purpose of this prescription is to provide special management for late-successional reserves and threatened and endangered species. It also includes special, selected sensitive wildlife species, which are primarily dependent on late-seral stage conditions. This prescription also emphasizes retention and enhancement of sensitive plant species, old-growth vegetation, and hardwoods. Sensitive fish and wildlife species, which are dependent on riparian areas, will be managed in accordance with the standards and guidelines in Riparian Reserves.

Specific standards and guidelines for late-successional reserves and managed late-successional areas (LRMP p. 4-44) are designed to maintain, enhance and protect these areas.

A network of reserves was established by the Northwest Forest Plan to provide old-growth forest habitat, provide for populations of species that are associated with late-successional forests, and to help ensure that late-successional species diversity would be conserved (USDA Forest Service 1999). This network consisted of Late-Successional Reserves (LSR), 100-acre core areas, and Managed Late-Successional Areas (MLSA). A set of management standards and guidelines was established for these areas and incorporated into the Shasta-Trinity National Forest's Land and Resource Management Plan (LRMP).

The management objective within LSRs is to protect and enhance conditions of late-successional forest ecosystems. Protection includes reducing the risk of large-scale disturbance, including stand-replacing fire, insect and disease epidemic, and major human caused impacts. The California Klamath Province and California Cascade Province, which both overlap the Squaw Valley Creek Watershed, have been identified as being included in an area of "elevated risk to large-scale disturbance due to changes in the characteristics and distribution of the mixed-conifer forests resulting from past fire suppression" (USDA Forest Service 1999). Risk reduction efforts are encouraged where they are consistent with the overall recommendations in management guidelines.

Within the forest-wide assessment of the network of LSRs on the Shasta-Trinity NF (USDA Forest Service 1999), catastrophic wildfire was identified as the greatest threat to further loss and degradation of habitat for late-successional associated species. This assessment refers to fuel reduction treatments within stands of late-successional and old-growth forest habitat as essential to maintaining and protecting them. It describes low to moderate intensity fire as one of the important ecological processes essential for the development and maintenance of late-successional and old-growth forest ecosystems (USDA Forest Service and USDI Bureau of Land Management 1994).

Within the LSR Assessment (USDA Forest Service 1999), the following objectives are described to guide the development and application of treatments within LSRs:

- Protect existing late-successional habitat from threats (of habitat loss) that occur inside and outside LSRs.
- Promote the continued development of late-successional characteristics.
- Protect mid and early-successional vegetation from loss to large-scale disturbance events.
- Promote connectivity of late-successional habitat within LSRs

As described by the Forest Plan (LRMP), the goal of wildfire suppression within LSRs is to limit the size of all fires. However, it also states “when watershed analysis, province-level planning, or Late-Successional Reserve assessments are completed, some natural fires may be allowed to burn under prescribed conditions” (LRMP p. 4-40).

Two levels of criteria were established within the LSR Assessment – the first level establishes priorities for the treatments of the LSRs within the network as a whole. The second set of criteria is developed to more specifically guide the placement of management activities within an LSR, and are to be used at the project level to identify treatment areas within and adjacent to an LSR. Objectives, criteria, and potential treatments are described to identify situations triggering further analysis, planning and implementation.

LSRs were identified that are currently at a high percent of the expected late-successional sustainable level and are at a high risk to loss by large-scale disturbance. Of the 24 LSRs analyzed on the Shasta-Trinity NF, the Iron Canyon LSR was one of the top four LSRs identified as having the greatest sustainable level of late-successional forest and that also have the highest risk.

The Iron Canyon LSR was identified as being at 66 percent of the expected late-successional sustainable level with 25,298 acres in size class 4 (i.e. 25-40” dbh) or above. It was also identified as having a 77 percent risk of high mortality (stand replacing) fire with 68,639 acres at risk of loss.

Administratively Withdrawn

Within the watershed analysis area, approximately 188 acres (less than 1 percent) lie within the administratively withdrawn land allocation. Although five management prescriptions apply to this allocation, all 188 acres fall within Management Prescription I (see Map 26 – LRMP Prescription). Per the LRMP, the following describes the management objectives for this prescription:

Management Prescription I – Unroaded, Nonmotorized Recreation: The purpose of this prescription is to provide for semi-primitive non-motorized recreation opportunities in unroaded areas outside existing wildernesses while maintaining predominantly natural-appearing areas with only subtle modifications. Special recreational and visual values, fisheries, and riparian resources are emphasized. Also emphasized in this prescription is retention of old-growth vegetation and management of wildlife species requiring late seral stage conditions.

Pages 4-45 through 4-51 of the LRMP detail the management prescriptions for Administratively Withdrawn Areas.

Matrix Lands

Within the watershed analysis area, approximately 44 acres (less than 1 percent) lie within the matrix land allocation (see Map 24). Although three management prescriptions apply to this allocation, all 44 acres fall within Management Prescription VI. Per the LRMP, the following describes the management objectives for this prescription:

Management Prescription VI – Wildlife Habitat Management: The primary purpose of this prescription is to maintain and enhance big game, small game, upland game bird and nongame habitat, thereby providing adequate hunting and viewing opportunities. Habitat management for species that are primarily dependent upon early and mid-seral stages is an important consideration. While this prescription does not emphasize those wildlife species dependent on late seral stages, habitat favorable to these species will occur within this prescription. Vegetation is manipulated to meet wildlife habitat management objectives and to maintain healthy, vigorous stands using such tools as silviculture and prescribed fire. Roaded natural recreation opportunities will be maintained.

Management prescriptions for the matrix land allocation are found in the LRMP on pages 4-64 through 4-67.

Riparian Reserves

The Northwest Forest Plan contains an Aquatic Conservation Strategy, which was designed to restore and maintain the ecological health of watersheds and aquatic ecosystems within the range of the northern spotted owl. The Aquatic Conservation Strategy directs the Forest Service to provide an area along streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystems as well, serving, for example, as dispersal habitat for certain terrestrial species (USDA Forest Service and USDI Bureau of Land Management 1994).

Riparian Reserves overlay all other land allocations (see Map 18). The riparian reserve widths prescribed in the Aquatic Conservation Strategy apply to all watersheds until watershed analysis is completed, a site-specific analysis is conducted and described, and the rationale for final riparian reserve boundaries is presented through the appropriate National Environmental Policy Act (NEPA) decision making process.

Currently designated Riparian Reserves in the watershed total approximately 13,541 acres, including streams within the watershed and geomorphological features such as inner gorges and slides and other unstable areas. Riparian Reserves encompass both federal and non-federal (private) ownerships within the Squaw Valley Creek Watershed.

Standards and guidelines for Riparian Reserves prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives. Specific standards and guidelines for Riparian Reserves are found in the LRMP on pages 4-53 through 4-60.

Roadless Designation

A significant portion of the southern half of the Squaw Valley Creek Watershed is designated as the West Girard roadless area. This inventoried roadless area is approximately 37,490 total acres in size and is designated as ‘non-wilderness’. Of this area, 19,227 acres are within the Squaw Valley Creek Watershed Analysis area, which accounts for 51 percent of the total analysis area (see Map 17).

The decision validating this designation was made through the second Roadless Area Rule and Evaluation (RARE II) environmental statement, from January of 1979 (USDA Forest Service). Compelling reasons for roadless areas being designated as non-wilderness are included in the environmental statement, but none specifically relate to any individual roadless areas. From the RARE II document, “entry into non-wilderness area and utilization of resources will be regulated by current laws, regulations, and within constraints of existing management plans.” RARE II inventoried roadless areas also designated as non-wilderness need not be considered further in wilderness-related analyses.

Subsequent to RARE II, the Roadless Area Conservation final rule and Record of Decision (ROD) was adopted in 2001 (36 CFR Part 294) and is commonly referred to as the ‘2001

Roadless Rule' or 'Roadless Area Conservation Rule.' The 2001 Roadless Rule prohibits new road construction and reconstruction in inventoried roadless areas on National Forest System lands except under specific circumstances (see 36 CFR Part 294).

The Secretary of Agriculture authored a memo on May 28, 2009 (Secretary's Memorandum 1042-154) reserving the Secretary "decision-making authority over the construction and reconstruction of roads and the cutting sale or removal of timber in inventoried roadless areas." Future foreseeable management actions within the West Girard Roadless Area will be addressed in other portions of this document. These actions include, at a minimum, the removal of small trees in order to maintain or restore ecosystem composition and structure as well as reduce the risk of uncharacteristic wildfire effects. There may also be a need to remove small diameter trees to improve habitat for threatened, endangered, proposed or sensitive species.

Chapter 2: Issues and Key Questions

Identification of issues and key questions related to resources in the watershed serves to focus the watershed analysis on those key elements that are relevant to management objectives, human values and resource conditions within the watershed.

Issue: Fire and Fuels

An overriding issue concerning fire and fuels revolves around fire hazard and fire risk. Past management activities such as successful fire suppression (mainly via initial attack of small fire starts) or lack thereof (timber harvest) has resulted in large areas with dense vegetation and fuel loading conducive to large fire growth and extreme fire behavior. Accumulated fuels through time heighten concerns over fire effects to resources (e.g. wildlife habitat, soils, human uses, hydrology, and air quality), public and firefighter safety, and fire behavior potential within and adjacent to the wildland-urban interface. Numerous fire starts occur every year within the watershed analysis area (71 starts from 1970 to 2006), and are primarily lightning caused (see Map 15). The combination of high fire risk and fire hazard in the watershed analysis area is, therefore, a major issue for the Squaw Valley Creek Watershed Analysis.

Key Questions

1. What is the current fire hazard and risk in the analysis area, including the threat to private land?
2. How does the current fire regime impact vegetation within the analysis area?
3. How might future high-severity fires affect other resources (e.g. air quality, erosion processes, human uses, soil fertility, water quality, fisheries, wildlife and botanical habitat)?
4. Under current management, what are the future trends for fire in the watershed?
5. What is the desired role of fire in the watershed?
6. What are fire and fuel management concerns within the analysis area, including fire suppression?
7. How does human usage within the watershed increase the potential for unplanned fires?

Issue: Habitat Quality

With late seral habitat (conifer tree size class >24”dbh) occupying almost half of the Squaw Valley Creek Watershed, and mid seral habitat (conifer tree size class 11-24” dbh) occupying an additional 43 percent, it is essential to develop an understanding of the factors influencing the overall condition and availability of this habitat as well as the risks to it (see Map 16). As a note, other factors besides tree size are assessed when designating habitat as late or mid-successional or old-growth. Tree size is only one aspect used in the analysis; other factors such as canopy closure and species composition are also considered. See Chapter 3 Species and Habitats or Vegetation sections for more details on the criteria used for assessing the seral stages within habitat types.

Late seral habitat has the potential to support multiple Forest Service Sensitive and federally listed species. There is a need to manage and protect what currently exists and to recruit additional habitat of this type for the future.

Other species associated with mid and early seral mixed conifer forests, limestone outcroppings and riparian habitat have the potential to occur in the watershed. These species include Forest Service Sensitive plants, amphibians, reptiles, bats, and mollusks, in addition to neotropical migratory birds and game species (see Chapter 3).

Because the Squaw Valley Creek Watershed contains federally designated Critical Habitat for the northern spotted owl (NSO), it is essential that the key elements that constitute suitable NSO habitat are considered when assessing the overall quality of the habitat within the watershed.

Key Questions

1. Does the current condition in the watershed have a desirable mix of seral stages, age classes, and vegetation types of terrestrial habitat for wildlife species?
2. What management actions can be undertaken to improve conditions where they are not in the desired condition and protect habitats that are?
3. How are existing conditions influencing the potential for high-severity wildfire to impact wildlife habitat?
4. How are existing conditions influencing the potential for high-severity wildfire to impact botanical habitat?

Issue: Late-Successional Reserve

The Iron Canyon Late-Successional Reserve (LSR RC-335) encompasses approximately 99 percent of National Forest lands within the Squaw Valley Creek Watershed Analysis area. The Squaw Valley Creek Watershed is one of six watersheds within or crossing this LSR. Habitat conditions vary among these watersheds. It is important to understand the role of this watershed and the effect that management actions will have on the overall functioning of the LSR.

Key Questions

1. What is the current condition of the LSR in the watershed?
2. What is the current risk to the LSR? How can the risk be reduced?
3. What is the desired role of fire in the LSR?
4. What is the future trend for development, maintenance and protection of late-successional habitat in the LSR?
5. How does the Iron Canyon LSR meet the criteria for prioritizing treatment areas both within the LSR network as a whole and as within individual LSRs as outlined in the forest-wide LSR Assessment?
6. What is the role of the Squaw Valley Creek Watershed in the functioning of the Iron Canyon LSR as a whole?

Issue: Access

The Squaw Valley Creek Watershed is a relatively isolated area within the larger McCloud River drainage. Due to its remote location and private landholdings, roads into the Squaw Valley Creek Watershed area are limited. There are only three main access roads (Girard Ridge Road, Squaw Valley Road and Hawkins Creek Road – all NFS roads) into the watershed (see Map 22).

Girard Ridge Road is accessible by the public at its southern terminus at Sims Campground and via Fall Creek Road near Castella, both of which are accessible via Interstate 5 along the Upper Sacramento River. Girard Ridge Road traverses along the western boundary of the Squaw Valley Creek Watershed along the watershed divide of the Tom Neal Creek drainage. Girard Ridge Road in turn provides access to Girard Ridge Lookout, the Tombstone Mountain Jeep Trail (which follows Girard Ridge for about 6 miles to Tombstone Mountain and the upper end of the Tom Dow Trail), and a several mile long unnamed spur road leading into upper Tom Neal Creek drainage (providing access to the upper end of the Tom Neal Trail). Girard Ridge Road was formerly open to public access from the north (via a private road off of Highway 89), but is now gated by private landowners.

Squaw Valley road, also known as Siskiyou County Road 1, is paved until Dairy Creek where it then crosses into Shasta County and becomes an NFS road. Approximately one mile south of the county line, Squaw Valley Road continues as a right turn off the paved road, and goes for about 3 miles as a wide well-graded unpaved road to the Cabin Creek Trailhead (which provides access to the Squaw Valley Creek Trail and the PCT). Beyond this point, the road continues as a wide well-graded unpaved road for about 2 miles to the saddle separating Cabin Creek and Beartrap Creek drainages. Here the road narrows, enters private ownership, is gated, and is closed to vehicle traffic.

An additional access challenge within the watershed relates not only to the limited number of roads in the area but also the condition of those roads. Most roads were originally constructed for forest management activities, resulting in roads that were passable mainly by high-clearance vehicles such as those employed for mechanical forest treatment. These roads, therefore, are largely not passable by passenger cars. Also, all of the routes in the lower watershed are designated as semi-primitive motorized recreation (see Map 21).

Other roads in the watershed (including the Bald Mountain Jeep Trail) are predominantly located on private properties with locked gates (Allen personal communication 2010).

The limited vehicular and trail access into the watershed may have potential management implications relevant to various resource areas (e.g. recreation, fire and fuels, wildlife, botany). The breadth of these potential resource implications informed the decision to note access as being a unique issue within the watershed.

Finally, Forest Plan direction indicates a need for reviewing access concerns.

"There is a continuing need to acquire rights-of-way for all improvements, such as roads and trails, over private or other lands not administered by the Forest Service. The objective is to acquire rights-of-way adequate for the protection, administration, and utilization of the National Forests or, where necessary, for the use and development of the resources upon which communities within or adjacent to the Forests are dependent" (USDA 1994 p. III-56).

Key Questions

1. How does a lack of access affect wildlife and rare plant species and habitats?
2. How does access affect noxious weed spread within the watershed?
3. How does a lack of access influence land management and land use practices, fire suppression capabilities and fuels and vegetation treatment activities?
4. How does a lack of access affect human uses and recreation?

Chapter 3: Current Conditions

The purpose of this chapter is to develop information relevant to the issues and key questions identified in Chapter 2. The current range, distribution, and condition of the relevant ecosystem elements are discussed.

Physical Features

Geology, Geomorphology and Erosional Processes

Geology

Geologic conditions and processes have been addressed in Chapter 1. The distribution of rock units is summarized in Table 2 below, which displays acres and percent of the land base, by rock type in the Squaw Valley Creek watershed. Unit Pvb consists of Cascade volcanic rock, Qhf consists of Holocene fluvial deposits, and the remaining rock units are older Klamath Mountains' rocks (see Map 5). More detailed mapping exists for the Cascades portion of the watershed (USGS 2002), but these data were not available electronically at the time of this analysis. Some of the rock units from Christiansen's work are described in the narrative below.

Table 2. Acres and percent landbase by bedrock type in the Squaw Valley Creek Watershed.

Map Unit Label	Map Unit Name	Description	Acres	Percent of Analysis Area
Cb	Baird Formation	Meta-pyroclastic, keratophyre, undifferentiated	3197	8%
Cbg	Bragdon Formation	Shale, greywacke,minor conglomerate	25,723	68%
Dc	Copley Greenstone	Greenstone and undifferentiated	411	1%
Dk	Kennett Formation	Siliceous shale, rhyolitic tuff, and undifferentiated	677	2%
EHaev	Everitt Hill	Andesite of Everitt Hill, pre-Sargents Ridge	618	2%
Mzd	Granitic Rock	Diorite, Yucaipa area: medium-to coarse-grained, texturally massive to slightly foliated biotite-hornblende diorite and quartz diorite. Relative age relation to Mzmg is uncertain	19	0%
Pmdk	Dekkas Andesite	Mafic flows and tuff with minor mudstone and tuffaceous mudstone; and undifferentiated	2,228	6%
Pmml	McCloud Limestone	Limestone	562	1%
Pmn	Nosoni Formation	Tuffaceous mudstone with lesser mafic flows, sandstone, cherty quartzite, and undifferentiated	1,282	3%
Pvb	Pliocene Volcanic-Basalt	Pliocene volcanic-basalt	410	1%
QHf	Holocene Fan Deposits	Holocene fluvial deposits	1,542	4%
QWf	Tioga-Age Fluvial Deposits	Tioga-age fluvial deposits	129	<1%
Qvt	High Cascades Superficial Deposit	Crystal pumice lithic tuff	814	2%

Geomorphology

The Geomorphic layer in the Shasta-Trinity GIS library reveals a pattern of long narrow inner gorges along main streams in the lower two thirds of the project area (see Map 9). There is a scattering of headwall basins in small, steep tributaries concentrated in the lower third of the watershed. These features are surrounded by a matrix of eroding hillslopes where fluvial and surface erosion processes operate. Deep seated landslides are very uncommon. Table 3 displays the area occupied by each of these geomorphic units. Active landslides are notably rare (Table 4). Slope steepness is summarized in five categories in Table 5.

Table 3. Acres, number of polygons, and percent of analysis area, by geomorphic map unit, in the watershed analysis area.

Geomorphic Map Unit Label	Description	Acres	Percent of Analysis Area
0111.01.0	Eroding hillslope	29797	79%
0121.03.0	Undifferentiated stream channel	4260	11%
0650.05.0	Headwall basin	2785	7%
0611.01.0	Undifferentiated slide	561	1%
0611.02.1	Rotational (slump) main scarp	45	<1%
0611.03.1	Rotational/translational main scarp	42	<1%
0622.01.5	Debris flow deposit	29	<1%
0611.02.7	Rotational (slump) bench	23	<1%
0121.13.0	Undifferentiated stream terrace	21	<1%
0611.02.8	Rotational (slump) toe zone	10	<1%
0621.01.0	Debris slide	7	<1%
0611.03.7	Rotational/translational bench	6	<1%
0121.01.0	Undifferentiated stream	<1	<1%

Table 4. Active Features, acres and number of polygons in the watershed analysis area.

Geomorphic Map Unit Label	Description	Acres	Percent of Analysis Area
1011	Undifferentiated debris flow	2782	7%
1012	Debris flow source zone	28	<1%
1251	Active slide	16	<1%
1260	Inner gorge	1431	4%
0111.01.0	Eroding hillslope	33	<1%
0121.03.0	Undifferentiated stream channel	2780	7%

Table 5. Acres and percent of analysis area, by slope, in the watershed analysis area.

Slope	Acres	Percent of Analysis Area
Very Gentle (0-10%)	2997	8%
Gentle (10-35%)	12306	33%
Moderately Steep (35-65%)	18628	50%
Steep (65-80%)	3139	8%
Very Steep (>80%)	516	1%

The 2006 Cumulative Watershed Effects assessment conducted by the Shasta-Trinity National Forest reveals that the potential for adverse cumulative watershed effects is highest in the Pig Creek/Dairy Creek and Willow Creek/Squaw Valley Creek 7th field watersheds. This is due to primarily to timber harvest and roads on both private and National Forest lands in those watersheds. Refer to the hydrology section for further information on this topic.

Hydrology

Squaw Valley Creek is approximately 32 miles long in its entirety, with approximately 18 miles within the analysis area. There are approximately 52 miles of perennial streams within the analysis area including Squaw Valley Creek. The Squaw Valley Creek Watershed drains an area of approximately 104 square miles. The analysis area is roughly 59 square miles. Peak flows occur during large storm events that typically take place during winter months. Base flows occur during summer months. Flows from snowmelt occur during spring, declining steadily into early summer with the lowest flow happening in late summer. Recovery of stream flow begins in the fall as evapotranspiration declines and seasonal rains begin. Flow recovery may also occur, to a lesser extent, as seasonal consumptive uses decline.

Discharge data from May 4, 2007 – November 2, 2007 for two sampling sites in the analysis area were available. The sampling sites are located on Squaw Valley Creek at Willow Creek, and at the confluence with the McCloud River. The sampling site at the confluence (SV-4) drains approximately 104 square miles (the entire Squaw Valley Creek Watershed) and the sampling site at Willow Creek (SV-3) drains approximately 66 square miles or 63 percent of the Squaw Valley Creek Watershed. Comparison of flows between the two sampling sites shows the Tom Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek Drainages contributed between 50 to 60 percent of the discharge while draining approximately 37 percent of the Squaw Valley Creek Watershed. Low flows at the SV-3 site ranged between 12-17 cfs in June – September of 2007. Low flows at the SV-4 site generally ranged 25 – 31 cfs during July – September. Flows gradually declined at both sites with the lowest flows occurring in August and September before the onset of precipitation events and vegetative dormancy. The flow at SV-3 reached base flows about a month earlier than SV-4. A local precipitation event also appears to have increased flows at the SV-4 site for a brief period in July. Peak flows during the sampling data period occurred on 11/19/2007 after significant precipitation. The peak flow discharge for SV-3 was 107 cfs and for SV-4, 181 cfs. The amount of precipitation in October was not unusual, however, in many years October receives little or no precipitation in this area. The amount of precipitation received in 2007 was substantially below average. Inferences for annual peak flows were not completed for this analysis due to limited data availability.

Springs and seeps are very abundant within both the Squaw Valley Creek Watershed and the watershed analysis area. Springs occur in two very different geologic types within this area. Water surfaces from fractures in lava rock and lava tubes in the northern areas of the Squaw Valley Creek Watershed such as at Pig Creek, where volcanics dominate the landscape as part of the Cascade Range. Springs in the southern drainages, however, appear at ground surface from fractures in limestone and dolomite outcrops that are part of the Eastern Klamath Mountains. Stream channels in both geological provinces within the Squaw Valley Creek Watershed form and then disappear as water becomes subterranean, resurfacing again at lower elevations, sometimes in other drainages. Both types of spring systems (volcanic and limestone) provide unique habitat and influence water quality. Except in the case of thermal springs, which occur outside the analysis area, water temperature decreases as it percolates through soil and rock. Water quality may also be influenced by chemical changes from interactions with parent material Filtration through this material may have a beneficial effect. Many of the springs and seeps within the analysis area are unmapped and likely several more remain undiscovered.

In 2003, Nestle Corporation proposed an industrial water use within Squaw Valley Creek Watershed. The recognition that the proposed water use had potential to affect the stream flow, and thereby affect water quality and downstream beneficial uses of Squaw Valley Creek, resulted in multiple hydrological studies of the Squaw Valley Creek and Upper McCloud River Watersheds. The reason that the Upper McCloud River was included in the studies is that there is an existing water diversion at Lakin Dam (Bigelow Meadow), on the Upper McCloud River, which diverts water to the old mill site in the town of McCloud where the water bottling plant has been proposed. These water rights were acquired by Nestle. Excess water diverted from the Upper McCloud has in the past been allowed to flow into Squaw Valley Creek, thereby enhancing its flows. Analysis of the data collected is ongoing. The final report from Nestle Corporation is anticipated in late 2011 (Palais, Nestle Corporation, 2011 personal communication).

Data included in the Nestle water study include stream flow, water temperature, and water quality monitoring. Development of a water balance model and a flow reduction experiment were also part of the hydrologic study. Multiple sites within the Squaw Valley Creek Watershed range from the headwaters to the confluence with the McCloud River. Several of the sites were pre-existing monitoring stations while others were added for the study. Flow data from this study were not available for this watershed analysis.

Current Water Uses

Diversions for agriculture, industry, and domestic use, which occur upstream and within the analysis area, contribute to changes in Squaw Valley Creek's base flow. The water source for the town of McCloud comes from both Intake Springs and the Elk Springs complex. Intake Springs is within the Squaw Valley Creek Watershed but upstream of the analysis area, and Elk Springs is located outside the analysis area, within the Upper McCloud River watershed. Approximately all but two cfs of the collectively diverted water is eventually returned to Squaw Valley Creek downstream of the diversions. The actual number of uses and amount of consumption are unknown. Most diversions and consumptive uses occur upstream of the analysis area, or in the Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek drainages. Just north of McCloud, there is a pipeline that diverted water from the Upper McCloud River Watershed to the old mill site above the town. The pipeline is not currently in use.

Groundwater in the upper Squaw Valley Watershed plays an important role in supplying water to the community of McCloud and the Squaw Valley Creek Watershed Analysis area. The measured discharges of smaller springs in the vicinity of Mount Shasta are described by Poeschel and others (USDI Geological Survey 1986). Many of these springs are intermittent, depending upon rainfall and the condition of the snowpack; highest flows are observed during the summer months. The groundwater movement and extent of the aquifer is not thoroughly modeled and is beyond the scope of this analysis.

Potential Future Water Uses

Pacific Gas & Electric (PG&E) has proposed cloud seeding in the Squaw Valley Creek vicinity. Cloud seeding is a form of weather modification performed by dispersing compounds - typically silver iodide and dry ice - into the atmosphere. PG&E is interested in cloud seeding as a means to increase local precipitation and, thereby, water yield. Concern has been raised by various members of the public regarding the proposed cloud seeding, many of whom oppose the practice based on perceived threats to environmental health including impacts to water quality, aquatic biota, wildlife, and human health. Other concerns are related to potential changes in precipitation patterns and possible flooding within the analysis area. There is some speculation that local precipitation enhancement may have offsite impacts that result in less precipitation in neighboring airsheds. The health effects and effectiveness of cloud seeding are widely debated. The future of cloud seeding and its potential effects to resources in the analysis area are unknown.

Stream Channel

Stream Channel Morphology and Condition

Stream channel morphology and condition vary within the analysis area. The Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek Drainages are in the upstream portion of the analysis area and are comprised of mostly privately-owned lands. Very little information specific to stream channel condition is available to the public. Tom Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek Drainages are located in the southern portion of the analysis area and comprised primarily of lands administered by the Shasta-Trinity National Forest. Drainage characteristics within northern and southern portions of the analysis area are discussed separately.

Northern Drainages

Squaw Valley Creek and the primary tributaries within the Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek Drainages have lower gradient pool-riffle, plane-bed, or step-pool channels. The majority of these stream segments are located in valley bottoms with less than 10 percent slope (Table 6). Approximately 29 percent of the Pig Creek-Dairy Creek Drainage's areal extent has slopes less than 10 percent, while 87 percent of its areal extent has slopes less than 35 percent. Willow Creek-Squaw Valley Creek is somewhat steeper; approximately 12 percent of its areal extent has slopes less than 10 percent and 62 percent of its areal extent has slopes less than 35 percent (see Map 27 – Slope within Watershed). Terrain that is more easily accessed and hospitable is predominantly privately owned and receives more human influence.

Willow Creek, Dairy Creek, Pig Creek, Cottonwood Creek, Connor Creek, and unnamed tributaries flow through meadows of varied size and wetness. Channels in these alluvial drainages are response reaches susceptible to disturbance and, as such, they require densely rooted vegetation to stabilize streambanks. Downcutting is reported in segments of Squaw Valley Creek, and may exist along tributary streams. Historic land use activities, including grazing, may have contributed to unstable stream sections. Stream restoration projects have occurred on private land within these drainages, most notably on Willow Creek Ranch.

Roads 38N11, 39N21, and MC1N01 (T R Sec 11, 14) are adjacent to Squaw Valley Creek for approximately 1.7 miles (see Map 22). Impacts to the creek in terms of decreased streambank stability and increased sediment are visible.

Private landowner interviews were conducted for the Upper McCloud River Watershed Assessment which also includes the Squaw Valley Creek Watershed. The landowners with large-scale properties included major timber harvest companies, ranchers, and recreational users (Henery 2008). Key findings from the interviews were:

1. The watershed was generally perceived as being healthy, and its health was improving.
2. Areas of perceived weakness in the watershed were fairly limited and specific.
3. Suggestions for watershed improvement, beyond those identified by the Red Band Trout Core Group, were relatively few and fairly general.

Table 6. Slopes in the Squaw Valley Creek Watershed.

HUC 7 Name	1: 0-10%	2: 10-35%	3: 35-65%	4: 65-80%	5: >80%	Total Acres
Pig Creek-Dairy Creek	1843.10	3675.43	787.79	7.66	2.77	6316.75
	29.18%	**58.19%**	**12.47%**	**0.12%**	**0.04%**	
Tom Dow Creek-McCloud River	97.78	1198.00	5132.39	1543.51	305.83	8277.50
	1.18%	**14.47%**	**62.00%**	**18.65%**	**3.69%**	
Tom Neal Creek	45.06	1594.52	5153.99	663.07	62.62	7519.25
	0.60%	**21.21%**	**68.54%**	**8.82%**	**0.83%**	
Trough Creek-Cabin Creek	127.43	2137.93	5326.85	829.28	124.25	8545.74
	1.49%	**25.02%**	**62.33%**	**9.70%**	**1.45%**	
Willow Creek-Squaw Valley Creek	814.03	3546.17	2203.21	94.60	20.63	6678.64
	12.19%	**53.10%**	**32.99%**	**1.42%**	**0.31%**	

Southern Drainages

The topography in the lower three Drainages - Tom Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek - is steep, rugged and remote. Approximately 85 percent of Tom Dow Creek-McCloud River Drainage's areal extent has slopes greater than 35%. Trough Creek-Cabin Creek and Tom Neal Creek Drainages are somewhat less steep with approximately 74 percent and 78 percent of the area having slopes greater than 35%. Vast areas in these drainages show relatively little impact from human use. Stream channels of Squaw Valley Creek and in the primary tributaries within the lower three drainages exhibit different characteristics. The channels are primarily cobble-, boulder-, and bedrock-dominated. These channels are transport reaches with higher gradients in steep valley bottoms. Upland drainages generally are undisturbed by land use activities. The steepness of these drainages makes these areas naturally susceptible to erosional processes when ground disturbing activities occur. Wildfire is the most likely disturbance that would occur on a large scale.

Road Densities

Road densities were calculated for each of the HUC 7 drainages (see Map 28 – Hydrologic Unit 7 Drainage) within the analysis area and are displayed in Table 7 below. These road densities vary considerably within the drainages, as some rather large tracts of land have relatively low road densities. Road densities for the Tom Dow Creek-McCloud River, Trough Creek-Cabin Creek, and Tom Neal Creek Drainages are relatively low; however, spatial location of the roads within these drainages is noteworthy. Most of the roads are located on ridge tops and are less likely to transport sediment into channels. One exception is the Beartrap Road, which closely follows Squaw Valley Creek through the Tom Neal and Tom Dow Drainages. The road is well constructed and maintained, minimizing impacts to the stream through implementation of Best Management Practices (BMPs).

Table 7. Road densities by HUC 7 Drainage, Squaw Valley Creek Watershed.

HUC 7 Name	Total Linear Miles	Density (mi/sq mi)
Trough Creek-Cabin Creek	17.18	1.29
Tom Dow Creek-McCloud River	7.54	0.58
Tom Neal Creek	14.53	1.24
Willow Creek-Squaw Valley Creek	60.57	5.80
Pig Creek-Dairy Creek	45.66	4.63

Cumulative Effects

A forest-wide analysis for prioritizing watersheds based on cumulative watershed effects and watershed value was completed in 2006 by the US Forest Service. Seventh-field drainages were placed into one of three RISK categories based on model integration of three categories (‘H’ = high; ‘M’ = moderate; ‘L’ = low), determined at the 33rd & 67th percentiles, resulting in the subdivision of 467 7th-field drainages into three nearly equal classes. Boundaries between categories are mathematical and assumptions about the condition of watersheds should not be inferred (USDA Forest Service 2006).

The risk category is based on 33rd and 67th percentile for all drainages evaluated. A total of 467 drainages were evaluated forest-wide. Scoring is based on using three cumulative effects models - Universal Soil Loss Equation (USLE), Geological Risk, and Equivalent Roaded Area (ERA). This analysis demonstrates the relative risk/disturbance drainages within the Shasta-Trinity NF. The results of this analysis indicate that stream channels for Pig Creek-Dairy Creek and Willow Creek-Squaw Valley Creek are at risk from cumulative effects. See Table 8 below.

Table 8. Risk category, score and relative rank of 7th-field drainages within the analysis area, as derived from the forest-wide cumulative watershed analysis (USDA Forest Service 2006).

Drainage	Risk Category	Score	Relative Rank
Trough Creek-Cabin Creek	Low	0.12	83
Tom Neal Creek	Low	0.19	152
Tom Dow Creek-McCloud River	Low	0.06	54
Pig Creek-Dairy Creek	High	0.42	337
Willow Creek-Squaw Valley Creek	High	0.54	398

High-severity, stand-replacing wildfires have the potential to seriously impair upland channels by removing vegetation and destabilizing hillslopes. Increased erosion occurring during subsequent precipitation events can deliver large volumes of sediment into the channel network. Increased runoff and hillslope erosion following vegetative loss can result in headward expansion of colluvial channels into swales. Impacts to upland channels in the adjoining McCloud River drainage following the Dee Fire of 1989 illustrates the hazards that high-severity fires pose to the aquatic environment. Wildfire especially that of high intensity is likely increase peak flows within the analysis area.

Water Quality

Publicly available water quality data, and water quality sampling data, for the Squaw Valley Creek Watershed analysis area are limited. Water quality from the springs used for the municipal water supply for McCloud is regularly sampled. Other springs in the upper watershed have been studied in past decades and indicate high quality water in the headwaters of Squaw Valley Creek.

Overall water quality in the analysis area is very high (Marine, North State Resources, and Palais, personal communications 2011). Water quality monitoring data from 2007 for two samples sites on Squaw Valley Creek were available for this analysis. The sites are located at the confluence of McCloud River (SV-4) and at Willow Creek (SV-3). These limited data indicate high quality water. Both pH and conductivity measurements varied between the two sites. Samples from SV-4 showed higher conductivity and pH than those from the SV-3 site. The difference in values is attributed to the change in parent material (limestone) in the lower drainages.

Although water quality is considered high in Squaw Valley Creek, water quality concerns have been identified. Water downstream of Squaw Valley is reported to have unusual amounts of foam and discoloration, most notably during summer months (Hesseldenz 2011 personal communication). Potential exists for contamination from sewage, both from the McCloud wastewater treatment facility sewer ponds and from private septic systems along streams. Older septic systems are considered more likely to contribute contamination due to proximity to surface water, design and leakage resulting from deterioration. Grazing and other land use practices may also contribute to nutrient loading. The meadows and wetlands in Squaw Valley are likely contributors of dissolved organic carbon (DOC) that produces foam naturally. Tannins and other organic debris are common sources of water discoloration that may be either natural or human-caused.

Mining for barite occurred in the western portion of the Tom Neal Drainage near Girard Ridge. The mine is located on private property and the site is not being actively mined. A land exchange for this parcel has been suggested to the Forest Service in order to manage lands within Tom Neal Drainage more holistically. Access roads to the mine, and exploratory sites for additional barite may be impacting water quality. Springs at the base of the limestone outcrop on top of which the mine is located may also be impacted by past mining activity. The water quality at the springs is unknown.

Biological Features

Vegetation

Current and past vegetation conditions were analyzed using vegetation maps obtained from the Forest Service Region 5 Remote Sensing Lab (RSL 2010). Historic activities and vegetation conditions were also researched and analyzed using published historical documentation. Current and historic spatial polygons of vegetation types in Geographical Information Systems (GIS) maps were compared and analyzed to determine vegetation types, distribution and change over time. Current vegetation types and conditions are based on the 2007 EVEG GIS layer contained within the Shasta-Trinity GIS Library (USDA Forest Service 2010).

Current vegetation conditions were also assessed by onsite observations (September 2010) to determine overall conditions and trends within the watershed. Spatial queries and analyses were conducted using US Forest Service GIS data (e.g. soil type, topography, water features and land management allocations).

The analysis area falls within the southeast extent of the Klamath Mountains Geological Province. Vegetation communities in the Squaw Valley Creek Watershed are strongly influenced by climate, land surface morphology and past management practices.

Vegetation is the physical expression of numerous environmental factors, both biotic and abiotic. Biotic factors influencing type and distribution of vegetation include, but are not limited to, sunlight, moisture, disturbance agents present (e.g. fire, insects, disease) and frequency of disturbance. Numerous abiotic factors influence vegetation such as soil, topography, aspect and location within the watershed. These factors combined, as well as others not mentioned, have largely influenced type and abundance of vegetation present in the Squaw Valley Creek Watershed Analysis area.

Currently, the Squaw Valley Creek Watershed is predominately forested with coniferous trees, with a small component of the watershed consisting of vegetative types other than conifer forest. Other vegetation present includes hardwoods, brush, perennial and annual grasses. Of the conifer dominated vegetation, the primary type present is Sierran-mixed conifer as classified by the Wildlife Habitat Relationship (WHR) vegetation types (Mayer and Laudenslayer 1988). Approximately 75 percent (28,315 acres) of the watershed consists of Sierran mixed conifer forests, and is in varying seral stages. The remaining 25 percent of the watershed is comprised of varying vegetation types, described in Table 9.

The mixed conifer forest of California is a complex association of ponderosa pine, sugar pine, Douglas-fir and white fir, within which any of these species may predominate. Incense-cedar also is a component, although it is not as abundant overall as the other species mentioned above. Generally, the five conifer species are intermixed either as single trees or as small groups. The overall successional stage of this mixed conifer forest is climax or late-successional. Disruptive agents such as fire, storm and insect attack cause internal shifts in species composition continually. Lack of disturbance enables expansion into lower elevation cover types while disruptions, particularly fire, cause the type to recede (USDA Handbook 445).

As this watershed analysis will show, there is a general lack of disturbance since European settlers arrived, an era commonly described as the 'fire suppression period'. Fire suppression, and thus missed fire return intervals, has significantly altered vegetative composition and structure and has also affected ecosystem processes within the watershed (Skinner et al. 2006). Conifer trees are present in greater densities than during historic periods. Increased conifer density is leading to reduced vegetative complexity, and may be leading to the reduction of forbs and grasses due to extensive shading and competition for site resources, namely available soil moisture. Timber harvesting has not been significant in this watershed, and thus has done little to influence vegetation patterns.

Vegetation and habitats within the Squaw Valley Creek Watershed are diverse on a local level, but less complex on a landscape level. Highly productive soils combined with high rainfall amounts and fire suppression has created ideal conditions for rapid tree growth. The historic heterogeneous landscape pattern has been replaced by a more homogeneous pattern of smaller openings in a matrix of dense forests (Skinner 1995) and spatial complexity has been reduced. There is a lack of early seral habitat in these conditions as the disturbance events (i.e. stand replacing fires) are human controlled and largely absent. The fire suppression era has resulted in the development of large areas of dense forests, largely replacing the early seral and open canopied fire climax forests (Daubenmire 1968, Skinner et al. 2006).

Within the Squaw Valley Creek Watershed, vegetation has been classified by WHR types that identify predominant species as well as size classes and canopy cover classes in tree dominated vegetation types. WHR types provide an ecological classification of groupings of vegetation that commonly occur together within geographic areas and elevation zones, and share a common developmental pattern of seral stages (Mayer and Laudenslayer 1988). Current vegetation types within the Squaw Valley Creek Watershed are displayed in Table 9 below and Map 14.

Table 9. Existing WHR types in the Squaw Valley Creek Watershed by ownership (Data from 2007 EVEG).

WHR Vegetation Type	Description	Category	Acres on Private land	Acres on Public land
AGS	Annual Grassland	non-forested	407	3
BAR	Barren	non-forested	16	16
LAC	Lacustrine – Water	non-forested	8	0
PAS	Pasture	non-forested	130	0
PGS	Perennial Grass	non-forested	169	0
URB	Urban	non-forested	21	0
WTM	Wet Meadow	non-forested	156	5
	Subtotal		**907**	**24**
MCP	Montane Chaparral	Brush	169	503
MCH	Mixed Chaparral	Brush	14	367
	Subtotal		183	870
MHC	Montane Hardwood-Conifer	hardwood/conifer	1,582	2,588
MHW	Montane Hardwood	Hardwood	178	1,500
MRI	Montane Riparian	Hardwood	215	1
VRI	Valley Foothills Riparian	Hardwood	50	0
	Subtotal		**2,025**	**4,090**
CPC	Closed-Cone Pine-Cypress*	Conifer	0	57
DFR	Douglas-Fir	Conifer	123	385
PPN	Ponderosa Pine	Conifer	221	30
SMC	Sierran Mixed Conifer	Conifer	10,987	17,328
WFR	White fir	Conifer	73	286
	Subtotal		**11,404**	**18,086**
	Total		**14,519**	**23,070**

*The WHR type CPC is labeled as “Closed-Cone Pine Cypress” however it does not specifically contain cypress species in this watershed.

WHR tree size and canopy cover classes are used to identify seral stages in forest stands. Seral stages are used to describe a sequential, directional change of vegetation development through time from bare ground (early seral) to a climax community (late seral). Under this concept, stands grow and shift along a continuum of development based on disturbance events. As such, a climax community is not a "final" or steady-state condition. Viewed as a continuum through time, late seral stands can be considered the farthest vegetation stage from a prior stand disturbance event.

Currently much of the forest vegetation is typed as late seral. This is due much in part to fire suppression activities that began in the early 1900s. Historic vegetation conditions and their change through time are further discussed in the next chapter. Table 10 lists the WHR size class, canopy class and seral stage of forested stands in the watershed.

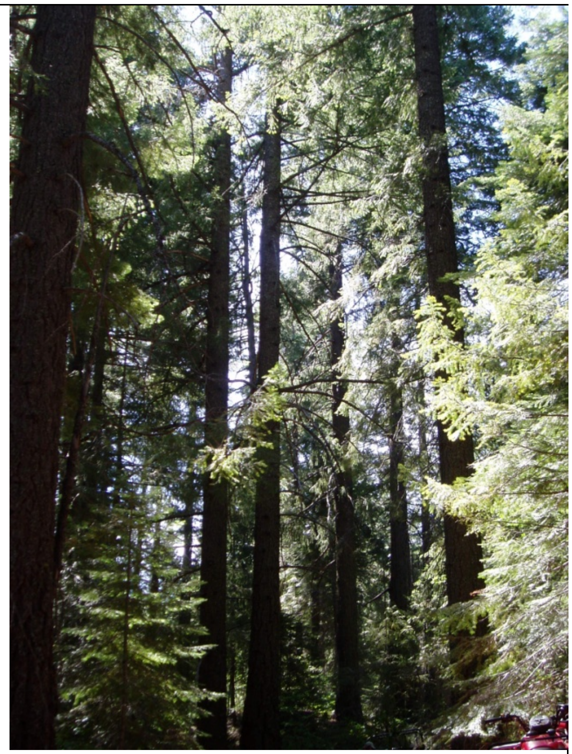
Table 10. Seral stage and canopy cover for vegetation types on public land in the Squaw Valley Creek Watershed.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% canopy closure)					% Per Size Class
		S (10-24%)	**P (25-39%)**	**M (40-59%)**	**D (60-100%)**	**Total Acres**	
Grass, Barren, Lacustrine, Others	Early seral	Density class not applicable				24	<1%
Brush; size = X		density class not applicable to brush				872	4%
1: < 1"		0	0	0	0	0	0
2: 1"-6"		2	2	10	128	142	<1%
3: 6"-11"	Mid seral	0	9	23	2,090	2,122	9%
4: 11"-24"		31	50	208	7,932	8,221	36%
5: > 24"	Late seral	0	0	8	11,679	11,687	50%
Total acres (forested)		**33**	**61**	**249**	**18,082**		
Total acres (public)						**23,068**	**100%**

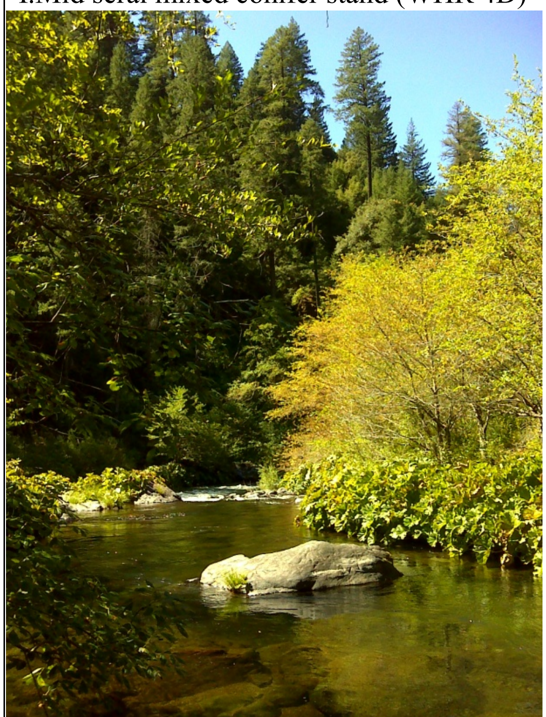
Note: Classification system is based on WHR Size and Density. Cover Size classifications for trees are Sparse (S), Open (P), Moderate Dense (D), Canopy closure percents relative to each classification appear in the table, after the letter in parentheses.

The lack of early seral habitats as well as diversity of vegetation types (i.e. 75 percent of the analysis area is mixed conifer) within the Squaw Valley Creek Watershed is noteworthy and may be of concern to resource managers. The current condition of the watershed as predominately conifer dominated with mid to late seral habitats creates ideal conditions for landscape level disturbance events. The lack of a diversity of age classes and varying vegetation patterns leads to decreased resilience. Under these conditions, wildland fires, insects or disease, if (when) present in the watershed, have an increased potential to affect larger areas. The homogeneous distribution of vegetation creates conditions that are ideal for widespread insect outbreaks and disease. On an individual tree level, there is high competition for available site resources, namely soil moisture, light and nutrients. Under these conditions, individual trees become stressed, and are much more vulnerable to insects and disease than under healthier conditions. When individual trees within stands are projected to the landscape level the competition for site resources is exponential. Ideal conditions currently exist for stand-replacing disturbance events, at local and possibly landscape scales, depending on the type and timing of such an event. Events that are commonly stand-replacing are insect outbreaks, abundance of disease or wildland fire events.

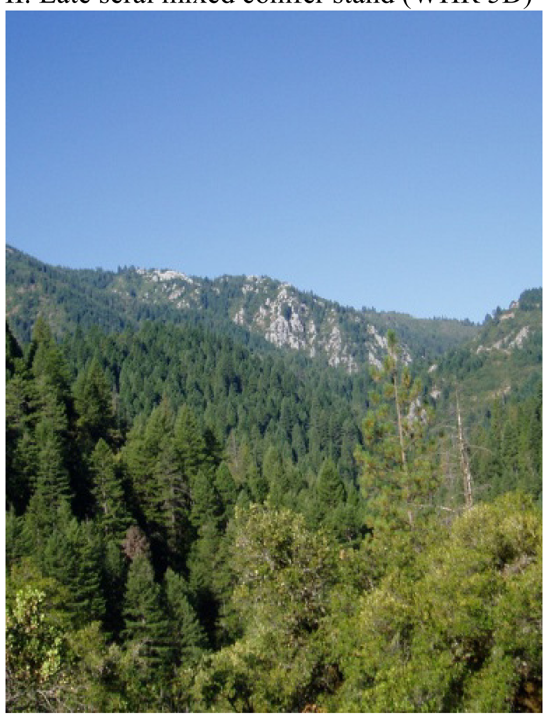
I.Mid seral mixed conifer stand (WHR 4D)



II. Late seral mixed conifer stand (WHR 5D)



III. Squaw Valley Creek, riparian vegetation



IV. Typical landscape vegetative conditions within the watershed

Figures I - IV. Photograph examples of vegetation conditions within the Squaw Valley Creek Watershed.

Fire and Fuels

Methodology

Predicting fire behavior and effects is important for fire and fuels management. Fire behavior and fire effects are created by fuelbed measurements (e.g. load, bulk density, particle size, heat content, and moisture of extinction) and formulated into fuel models (Scott and Burgan 2005). Fuel models, weather and topography are the inputs for fire modeling and are used to predict fire behavior and fire effects in this watershed analysis.

Fire behavior modeling was done using Flammap. Flammap is a fire behavior mapping and analysis program that computes fire behavior characteristics for a landscape using constant weather and fuels moisture conditions. Outputs consisted of crown fire potential and flame length potential (Finney 1998). In addition, all fire model runs were calculated using the California Fuels Landscape, which uses the vegetation layer to obtain fuel models.

Fire Family Plus is software for analyzing and summarizing historical weather observations and computing fire danger indices of the National Fire Danger Rating System (NFDRS). Weather and fuel moisture data were evaluated at 50th percentile or dry conditions and 90th percentile or very dry conditions using Fire Family Plus. Fire Family plus is used to generate 'NFRDRS Pocket Cards' for a given area of interest.

Modeling Outputs

The Shasta Trinity National Forest Fire Danger Pocket Cards (defined as a measure of fire danger indicators and relationships by comparing current conditions to historic thresholds) indicate that, 50th percentile weather conditions are when growth of fires and fire suppression concerns start to occur. Fuel moistures under such conditions are dry. Fires under 90th percentile weather conditions have demonstrated significant fire growth and fire effects. Fuel moistures under those conditions are very dry.

For the watershed analysis, only fire modeling outputs from 90th percentile weather conditions are displayed. These conditions are intended to mimic a scenario that could result in extreme fire behavior and large fire growth. Fire effects potential to private lands and resources under very dry conditions are also displayed. In addition, areas of concern from fire effects between 50th and 90th percentile weather conditions did not change, but were less or more prominent depending on weather and fuel moisture inputs into Flammap.

The Shasta Trinity National Forest Fire Management Plan evaluates current fire risk and fire hazard on a variety of values that could be threatened (Appendix G, Fire Management Plan 2010). The following analysis will be similar in process and assumptions but is site specific for the analysis area.

Fire Hazard

Fire hazard can be characterized by how a fire will burn or fire behavior. Fire behavior is the product of the natural environment or the unique combination of topography, weather and fuels (Countryman 1972). Topography and weather are factors on which humans have little effect. Fuels can be altered through human intervention or natural processes such as fire (rapid) or decomposition (very slow). Therefore, when assessing fire hazard, the focus can be on fuels and the associated fire behavior.

Fuels

Table 11 displays the fuel models in terms of description, acres, and percentage of each category of fuels in the watershed analysis area. These fuels models are derived from the vegetation layer and can describe fire behavior based on weather, topography, and weather characteristics.

Table 11. Fuel models within the watershed analysis area in acres and percentage of area.

Fuel Model and Category	Description	Percent Within Analysis Area / Acres
Grass Fuel Models		
101 -- GR1	The primary carrier of fire in GR1 is sparse grass, though small amounts of fine dead fuel may be present. The grass in GR1 is generally short, either naturally or by heavy grazing, and may be sparse or discontinuous. Predicted spread rate and flame lengths are low.	1% / 499 Acres
Shrub Fuel Models		
142 -- SH2	The primary carrier of fire in SH2 is woody shrubs and shrub litter. Moderate fuel load (higher than SH1), depth about 1 foot, no grass fuel present. Spread rate is moderate; flame length moderate.	1% / 401 Acres
Timber-Understory Fuel Models		
165 - TU5	The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length high.	38% / 14,358 Acres
Timber-Litter Fuel Models		
183 -- TL3	The primary carrier of fire in TL3 is moderate load conifer litter, light load of coarse fuels. Spread rate is very low; flame length very low.	3% / 1,030 Acres
184 -- TL4	The primary carrier of fire in TL4 is moderate load of fine litter and coarse fuels. Includes small diameter downed logs. Spread rate is low; flame length low.	3% / 1,146 Acres
188 -- TL8	The primary carrier of fire in TL8 is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length low.	8% / 2,817 Acres
189 -- TL9	The primary carrier of fire in TL9 is very high load, fluffy broadleaf litter. TL9 can also be used to represent heavy needle-drape. Spread rate is moderate; flame length moderate.	36% / 13,406 Acres
Slash-Blowdown Fuel Models		
202 -- SB2	The primary carrier of fire in SB2 is moderate dead and down activity fuel or light blowdown. Blowdown is scattered, with many trees still standing. Spread rate is moderate; flame length moderate.	6% / 2,344 Acres
Other Fuel Models		
Other	Other fuel models within the analysis boundary less than 400 Acres and make up a small percentage of the total area.	4% / 1,585 Acres
Descriptions based on Anderson 1982 and Scott and Burgan 2005. Fuel models derived from the California Fuels Landscape created by the Region 5 Stewardship and Fireshed Analysis Team and clipped to the analysis area in GIS.		

Fire Behavior

Flame Lengths

Flame lengths, a measure of how intense or severe a fire may become and a proxy for ease of fire suppression, were used to model and predict fire behavior. Flame lengths are described in the Fire Management Plan and Appendix B of the Fireline Handbook as follows:

Low – Flame lengths 0 to 4 feet. Persons using hand tools can generally attach fires at the head or flanks of the fire.

Moderate – Flame lengths 4 to 8 feet. Fires are too intense for direct attack on the head of the fire by persons using hand tools. Equipment such as dozers, engines and retardant aircraft can be effective.

High – Flame lengths greater than 8 feet. Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.

Table 12 displays potential flame lengths for the analysis area. Map 29 in Appendix C displays a map of flame length potential in the analysis area.

Table 12. Fire behavior potential based on flame lengths under 90th percentile weather.

Flame Lengths	Acres	Percent Total Area
Non-flammable	166	<1%
Low 0-4 ft	17139	46%
Moderate 4-8 ft	9311	25%
High > 8 ft	10970	29%
Total	**37586**	**100%**

Crown Fire Potential

Crown fire potential is a measure of how severe a fire may become under specified conditions. Canopy characteristics, ladder fuels and fuel loading are all factors that determine crown fire potential. Model limitations include the transition of passive and active crown fire and poor parameterization of canopy fuels; as a result, under-prediction of active crown fire compared to observations is common (Fule et al. 2001, Scott and Reinhardt 2001, Cruz et al. 2003, and Stratton 2004). Crown fire measures are defined as the following:

Surface fire - The fire remains on the forest floor. The combination of surface fire intensity and ladder fuels is not sufficient to move a fire into the crowns under the defined burning conditions.

Passive Crown Fire - Individual tree or group torching occurs. The combination of surface fire intensity and ladder fuels allows for movement into the crowns under the defined burning conditions, but canopy bulk density is too low for fire to spread through the crowns under the projected wind speeds.

Active Crown Fire - The combination of surface fire intensity, ladder fuels and canopy bulk density allows fire to move into, and spread through, the crowns under the defined burning conditions.

Table 13 (and Map 30 – Crown Fire Potential) displays crown fire potential in the analysis area under 90th percentile weather conditions. These data are calculated to depict the potential for crown fire given the current fuel loading if a fire where to occur during a period when the fuel moisture/weather conditions are in the 90th percentile or above for fire weather (i.e. hot, dry, windy).

Table 13. Crown fire potential under 90th percentile weather.

Fire Classification	Acres	Percent Total Area
Non-flammable	164	<1%
Surface fire	18,015	48%
Passive crown fire	19,388	52%
Active crown fire	19	<1%
Total	**37,586**	**100%**

Fire Risk

Fire risk is defined in the Fire Management Plan as the probability of a fire start occurring over a ten year period for a given 1000-acre area. Fire risk is based on the Shasta Trinity National Forest GIS layers for fire occurrence records within the analysis area. The risk classification within the Fire Management Plan is as follows:

- Low Risk = 0 to 0.49: Less than 0.5 fires expected to occur per decade for every thousand acres in the area being analyzed
- Moderate Risk = 0.50 to 0.99: Between 0.5 and 0.99 fires expected to occur per decade for every thousand acres in the area being analyzed
- High Risk = At least one fire expected to occur per decade for every thousand acres in the area being analyzed

Within the 37, 586 acre project boundary 58 fire starts occurred over a 30 year period (1977 to 2007).

Risk value, or R, is calculated using the following formula:

R = $\{(x/y)\ 10\}/z$ where:

x = fire starts = 58

y = period analyzed =30 years

z = number of acres analyzed =37,586 displayed in thousands = 37.6

Risk rating = {(58/30) 10}/37.6 = 0.51 (Moderate Risk).

The analysis area has a moderate fire risk value. Approximately seventy-four percent of ignitions are lightening caused and twenty-six percent are human caused. The majority of the human caused fires were on private land within the watershed analysis boundary. Despite numerous fire starts over recent years, there has been no fire over 200 acres within the analysis area during this 30-year period (see Map 15).

Current Fire Regime Impacts to Vegetation

Vegetation patterns are influenced by disturbance history. Approximately 99 percent of the analysis area has not been affected by a fire over the past 80 years. The lack of disturbance in the analysis area has increased forest density and fuel loading with a shift to higher proportions of fire-intolerant species compared to historical periods. Therefore, there is an increased probability of passive or active crown fires throughout the watershed analysis area.

An analysis was conducted to determine current fire behavior potential on existing vegetation communities (Table 14) and size class (Table 15) to gain an understanding of fire effects. The dominant WHR types from the 2007 EVEG GIS layer were used for this analysis.

Table 14. Flame length fire behavior potential (acres) by dominant vegetation type.

Dominant Vegetation Type	Low (0'-4')	Moderate (4'-8')	High (>8')
Annual Grass	**398**	**7**	**5**
Barren	31	0	0
Closed-Cone Pine-Cypress	17	35	5
Douglas Fir	480	22	30
Lacustrine	8	0	0
Mixed Chaparral	316	113	88
Montane Chaparral	377	128	28
Montane Hardwood-Conifer	1,787	996	1,393
Montane Hardwood	778	215	684
Montane Riparian	208	8	1
Pasture	129	0	0
Perennial Grass	169	0	0
Ponderosa Pine	166	61	23
Sierran Mixed Conifer	12,051	7,609	8,670
Urban	22	0	0
White Fir	207	117	43
Wet Meadow	161	0	0
Total	**17,305**	**9,311**	**10,970**

Table 15. Flame length fire behavior potential (acres) by tree size class.

Size Class (DBH)	Low (0'-4')	Moderate (4'-8')	High (>8')
1 - 5.9"	370	83	140
6 - 10.9"	1,931	1,025	1,272
11 - 23.9"	8,577	4,572	3,783
> 24"	4,982	3,423	5,666
Unclassified	1,420	207	115

The role of fire has been significantly reduced from historical fire return intervals. Without regular disturbance patterns in place the analysis area has seen an increase in stand density and fuel loading, primarily represented by fire intolerant species which were not favored historically. This has increased the likelihood of fires to burn with uncharacteristically high intensity and severity; potentially leading to a stand replacing event throughout the watershed analysis area.

An analysis of historical fire return intervals (pre-suppression era) has been compared to contemporary fire return intervals (suppression era) for the analysis area. This analysis is known as a condition class based on departure of fire return interval. The historic fire return interval ranged from approximately 3 to 38 years with a mean of 12.75 years (Skinner 2006). The range of historic fire return intervals is largely based on a combination of biophysical values such as existing vegetative condition, topography, soil and hydrologic functions, climate and others that influence vegetation development.

The following equation is used to determine departure of fire return intervals:

{1-(reference FRI/Current FRI)} * 100

The value obtained depicts a percentage difference, and condition class is determined by the use of the Landfire National Scale (where 0-33% = Condition Class 1, 34-67% = Condition Class 2, greater than 67% = Condition Class 3). Figure X depicts condition class by approximate acres of departure from historic fire return interval.

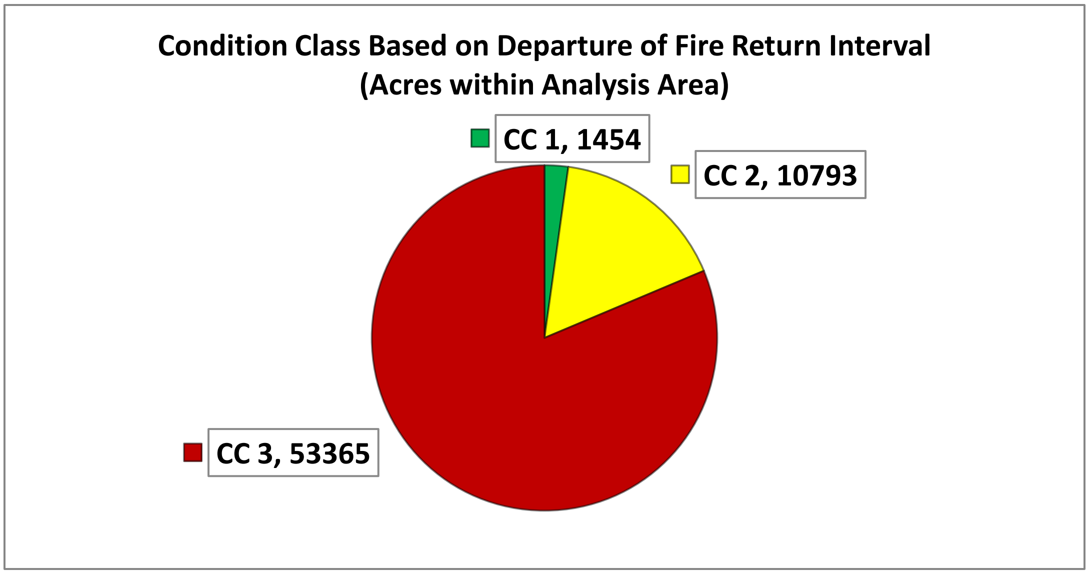


Figure V. Condition class departure based on historic fire return intervals displayed in approximate acres per condition class.

Impacts of Fire on other Resources

Air Quality

Air quality can be evaluated in terms of visibility and the concentration of pollutants. Wildfire, residential wood and trash burning, agricultural and prescribed burning, asbestos from asbestos containing rock and road construction can create smoke or dust. Smoke and dust have the potential to affect air quality. Fire produces carbon monoxide, suspended particulate matter (PM_{10} and below) and polycyclic hydrocarbons as pollutants. The smoke produced by fires can affect visibility as well as other air pollutant standards.

Smoke- and/or dust-producing activities on National Forest lands are regulated by the Federal Clean Air Act, the Shasta-Trinity NF LRMP and the California Air Resources Board. Standards established therein are also useful in measuring the impact of wildfires on air quality.

Air quality was noticeably poor at various times in Northern California from August through October of 1987, 1999 and 2008 due to large wildfires on the Shasta Trinity, Klamath and Six Rivers National Forests. Monitoring at the community of Hoopa, California indicated that, as a result of the Big Bar Complex fires (1999), California 24-hour PM_{10} standards were exceeded on 19 days and the federal standard was exceeded on 12 days. During several days, average PM_{10} standards were greater than 420 ug/m^3 − which is considered hazardous. The smoke from the fires precipitated the first declared state of emergency in a California county due to air pollution (Herr 1999).

As fire risk and high fire behavior potential in the analysis area increase, periods of poor air quality during wildfires are likelier to occur.

Erosion Processes and Soil Productivity

Fires may affect soil properties and erosion processes. Areas that burn with a moderate to high intensity often lose their duff layer. The duff layer provides protection from erosion processes, a supply of nutrients to the soil, and a natural reserve of nutrients for long-term soil productivity needs. Areas burned with high intensity also lose nitrogen by volatilization processes in the surface inch of soil. The loss of soil nutrients from fire volatilization of above- and below-ground organic material and from accelerated erosion processes impacts soil and site productivity.

Water Quality and Aquatic Species Habitat

Water quality is directly related to aquatic species habitat needs. Increased delivery of sediment to streams from upland erosion and elevated stream temperatures from loss of overstory canopy shade in the wake of high-intensity fires may reduce water quality and degrade habitat for local fish populations.

Terrestrial Wildlife Habitat

As discussed above, fire effects on vegetation also influence wildlife habitat and populations. Wildfire can potentially limit foraging resources, as well as predator protection and thermal protection for northern spotted owls. Conversely, fire can improve browse for elk, bear and other species and increase snag habitat for snag-dependent species. See the Species and Habitat discussion for a more detailed description of the inter-relationship between fire and wildlife habitat and populations.

Human Uses

Fire effects to the above resources in turn impact the recreation experience and other human uses in the analysis area. Such impacts include, but are not limited to, a degradation of visual quality near large areas of burned landscape, restrictions on motorized and non-motorized recreation (e.g. road closures, smoke issues) poor air quality during wildfire events, as well as degradation of water quality and related effects to fishing, rafting, etc.

Fire Suppression Concerns within the Analysis Area

Fire suppression capability is a major concern within the analysis area. Numerous fire starts coupled with steep terrain, limited access, dense fuels conditions and weather patterns conducive to large fire growth have created fire-suppression concerns in the past and continue to drive the concerns of managing future wildfires. These factors also may delay adequate response times to fire starts, increasing the likelihood of a fire becoming larger. Although initial attack efforts have been relatively successful to date, if a wildland fire were to exceed the capabilities of aerial suppression, ground efforts would be greatly hindered due to access constraints (see Map 22).

Additionally, fire and fuels management and treatments (e.g. fuels reduction treatments) are also limited due to limited access into and within the watershed. Fire and fuels treatments are generally undertaken to reduce fire behavior potential and fire effects. Fire and fuels based treatments would increase fire suppression capabilities, increase the ability of fire to play a natural role in the ecosystem as well as decrease the risk of undesired wildland fire. Increases to the transportation system and maintaining key system components are necessary to effectively manage fire and fuels within the analysis area.

Species and Habitat

Threatened, Endangered and Sensitive (TES) Plants and Other Species of Concern

Information concerning current fire regime impacts to populations or habitat conditions of TES plants, Survey and Manage plants, and CNPS watch list plants occurring in the Squaw Valley

Creek Watershed is limited. There has been only one recent (<10 yrs) survey for the species addressed in this report in or near the analysis area and the survey included only a small portion of the Squaw Valley Creek Watershed (Pacific Gas & Electric 2009).

Methodology

Habitat for or occurrences of TES plants, Forest Endemic plants, and Survey and Manage plants occurring in the Squaw Valley Creek Watershed were assessed using Natural Resources Information Systems (NRIS) and California Natural Diversity Database (CNDDB) Element Occurrence Records, NatureServe Explorer (2011), Bureau of Land Management Plant status information (BLM 2010), results of past floristic and rare plant surveys, the California Native Plant Society (CNPS) online Inventory of Rare and Endangered Vascular Plants of California (CNPS 2010), current vegetation information (Lindstrand and Nelson 2006), and site observations (October 2010).

- **Shasta eupatory *(Ageratina shastensis)*** is a perennial subshrub classified as CNPS List 4.2 (i.e., limited distribution [watch list]; fairly endangered in California) and Forest Service Endemic. Shasta eupatory is limited to Shasta County and frequently occurs on limestone substrates (Hickman 1993) in both chaparral and lower montane coniferous forest at elevations from 1,300 to 5,900 feet (CNPS 2010). There are two documented populations of Shasta eupatory (1980, 1983) in the watershed and eight more within five miles of the watershed boundary. The documented populations occur on or in close proximity to a limestone substrate and within the following vegetation types (Douglas-fir, montane hardwood, mixed chaparral, Sierran mixed conifer, and white fir).
- **scabrid alpine tarplant *(Anisocarpus scabridus)*** is a perennial herb classified as CNPS List 1B.3 (rare, threatened, or endangered in CA and elsewhere), Forest Service Sensitive (FSS), and BLM Sensitive (BLMS). Scabrid alpine tarplant can be found on rocky, open subalpine slopes in the North Coast and southern Cascades ranges, generally between 5,500 to 7,500 feet elevation. The nearest documented occurrence of scabrid alpine tarplant to the Squaw Valley Creek Watershed is approximately seven miles east of the watershed boundary in a on a rock outcrop along Grizzly Peak.
- **veiny arnica *(Arnica venosa)*** is a perennial rhizomatous herb classified as CNPS List 4.2 and Forest Service Endemic. Veiny arnica typically occurs between 2,000 to 5,200 feet elevation, within coniferous or oak forests especially on ridge tops, road cuts, or within disturbed areas (Hickman 1993). There are eight documented populations of veiny arnica within five miles of the watershed boundary, all of which occur in a variety of vegetation types (Douglas-fir, montane hardwood conifer, Sierran mixed conifer).
- **northern clarkia (*Clarkia borealis* ssp. *borealis*)** is an annual herb classified as CNPS List 1B.3, FSS, and BLMS. It is endemic to California, and locations are known only in Shasta and Trinity counties (CNPS 2010). Northern clarkia prefers cismontane (western slope) and foothill woodlands, chaparral, and lower montane coniferous forest habitats between the elevations of 1,300 and 4,400 feet. There is one documented population within five miles of the watershed within a Sierran mixed conifer vegetation type.
- **mountain lady's slipper *(Cypripedium montanum)*** is a perennial herb classified as CNPS List 4.2, FSS, BLMS, and List C (uncommon, pre-disturbance surveys practical) Survey and Manage Species. Mountain lady's-slipper habitat is broad, occurring in Douglas-fir, white fir, and mixed conifer forests that are in the mid-late seral stages, as well as oak woodlands and riparian areas. Most occurrences in the western Cascades are between 2,500 and 4,000 feet elevation, on northern aspects, on 25 - 50 percent slopes, and with a canopy closure

between 60 and 80 percent (Seevers and Lang 1998). There are two documented occurrences approximately two and a half (2.5) miles west of the watershed boundary near Soda Creek within Sierran mixed conifer and montane hardwood conifer vegetation types.

- **Butte County fritillary *(Fritillaria eastwoodiae)*** is a perennial herb classified as CNPS List 3.2 (i.e., more information needed about this plant [review list]; fairly endangered in California) and FSS. Its distribution is limited to the Cascade Range, specifically Tehama, Butte and Shasta Counties (Hickman 1993). Butte County fritillary is found in chaparral and cismontane woodlands on dry benches and slopes as well as openings in lower montane coniferous forest at 164 to 4,920 feet elevation (CNPS 2010). There are seven documented occurrences of Butte County fritillary on the Forest with the nearest occurrence approximately six miles outside the watershed boundary.
- **Shasta snow-wreath *(Neviusia cliftonii)*** is a shrub classified as CNPS List 1B.2 (i.e. rare, threatened, or endangered in CA and elsewhere), FSS and BLMS. Shasta snow-wreath is found in cismontane woodlands, lower montane coniferous forest and riparian woodlands along streamsides. This species was previously considered associated with limestone substrates (CNPS 2010, Hickman 1993); however, newer information indicates that nearly half the documented occurrences in Shasta County grow on non-limestone substrates (Lindstrand and Nelson 2006) between 984 and 1,640 feet elevation. The twenty-three documented occurrences of Shasta snow-wreath on the Forest exist between 8 to21 miles outside of the watershed boundary. Habitat for Shasta snow-wreath exists within the watershed analysis area.
- **Pacific fuzzwort *(Ptilidium californicum)*** is a bryophyte not yet ranked in the NatureServe or CNDDB databases. Pacific fuzzwort is a Forest and BLM sensitive species as well as a Survey and Mange List A (Rare, Pre-Disturbance Surveys Practical). Pacific fuzzwort is generally found growing at the base of large white fir trees, stumps and logs in relatively undisturbed old-growth late seral habitats above 4000 feet elevation. The closest documented occurrence of Pacific fuzzwort to the watershed analysis area is approximately three miles north of the analysis area along Thimbleberry Ridge in a Sierra mixed conifer vegetation type.
- **English Peak greenbriar *(Smilax jamesii)*** is a perennial rhizomatous herb rated CNPS 1B.3, FSS and BLMS. English Peak greenbriar generally occurs along lakesides, stream banks, and riparian areas in moist montane coniferous forest between 2,900 to7,500 feet elevation. The closest documented occurrences of English Peak greenbriar to the analysis area are east of the Squaw Valley Creek Watershed along the McCloud River, one in a montane hardwood conifer type and the other in a Sierran mixed conifer vegetation type.

Much of the forest in the watershed is typed as late seral conifer (see Vegetation discussion in Chapter 3). This may be particularly good habitat for plant species such as the mountain lady's slipper and the Pacific fuzzwort which require shaded areas containing large diameter trees. This forest seral condition is due in part; however, to the effective efforts of fire suppression (see Fire and Fuels section). In addition to late-successional, mixed conifer forest, there are a variety of habitats including montane hardwood, oak woodland, annual and perennial grassland, riparian corridors, limestone outcroppings and caves, though these other habitats are a small percentage of the overall watershed (see the Vegetation section for further discussion).

Fire suppression has also created an over-accumulation of fuels and a homogeneous array of small openings within a matrix of dense forest within the watershed. This vegetation density may not be advantageous for the perpetuation of certain rare plant species due to competition for resources (e.g. nutrients, water), space, or sunlight (Vance 2007).

As noted in the Late-Successional Reserve and Wildlife discussions, “catastrophic” (i.e. very high severity) wildfire was identified as the greatest threat to further loss and degradation of habitat for late-successsional associated species (USDA Forest Service 1999). Fuel reduction treatments, particularly through the use of low- to moderately intense prescribed fire, is encouraged to develop and maintain late-successional habitats. Plant species such as the Pacific fuzzwort, mountain lady’s slipper, as well as several others may benefit from this direction.

Human disturbance within the watershed does not play an apparently large role in the threats to these botanical species of concern. Access to the watershed for recreation (hiking, OHV, camping, etc.) is limited (see Access and Human Uses sections) therefore direct impacts such as trampling or poaching of species on public lands is not of serious concern at this time. The dominant uses of private land in the watershed include recreational fishing, private timber management, and agricultural lands. Access to these regions is also limited, suggesting low human threat to botanical species of concern; however, more information is needed to make accurate assessments of these potential threats.

Distribution and abundance data regarding botanical species of concern in the watershed are greatly lacking. Further surveys and monitoring of these species and their habitat conditions are needed.

Noxious and Undesirable Weed Species

Methodology

Current habitat conditions of noxious weeds occurring in the Squaw Valley Creek Watershed were assessed using Natural Resources Information Systems (NRIS) Element Occurrence records, results of past floristic surveys, California Invasive Plant Council (Cal-IPC), California Department of Food and Agriculture (CDFA), and current vegetation information supplied by the Forest. Species description information (i.e. morphology, blooming period, habitat type) was taken from Hickman 1993, Bossard et al. 2000, and DiTomaso and Healy 2007. Table 16 explains the two main rating systems (Cal-IPC and CDFA) in California regarding noxious weeds.

Table 16. Noxious weed rating systems used for analysis.

CDFA Rankings	Cal-IPC Rankings
A – Eradication, containment, rejection, or other holding action at the state-county level. Quarantine interceptions to be rejected or treated at any point in the state.	**High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
B – Eradication, containment, control or other holding action at the discretion of the commissioner.	**Moderate** – These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their

CDFA Rankings	**Cal-IPC Rankings**
	reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
C – State endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner; reject only when found in a cropseed for planting or at the discretion of the commissioner.	**Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Documented Weed Infestations

Documented noxious weed surveys in the watershed have been limited. The Pacific Gas and Electric (PG&E) McCloud-Pit Federal Hydroelectric Power Relicensing (2007, 2008) project is the only noxious weed survey documented in or near the Squaw Valley Creek Watershed.

The following select noxious weed species are documented in the Squaw Valley Creek Watershed and are of high concern on the Forest:

- **tree of heaven (*Ailanthus altissima*)** is a deciduous tree rated as moderately invasive by Cal-IPC. Tree of heaven is a fast-growing species that spreads rapidly either by seed or by root sprouts and may appear in disturbed urban and semi-natural environments and waste areas. There is one documented occurrence of tree of heaven approximately five miles west of the watershed analysis area in the Sims Flat campground.
- **nodding plumeless thistle (*Carduus nutans*)** is a perennial herb rated as moderately invasive by Cal-IPC and List A by CDFA. Nodding plumeless thistle typically grows in disturbed habitats (e.g. roadsides, ditches) and pastures under 6,000 feet elevation. There are six documented occurrences of nodding plumeless thistle within five miles of the watershed analysis area boundary. These populations occur along the east side of the Squaw Valley road and within the Snowman's Hill snowpark near Highway 89.
- **Italian plumeless thistle (*Carduus pycnocephalus*)** is an annual herb rated as moderately invasive by Cal-IPC. Italian plumeless thistle grows along roadsides, pastures, and waste areas below 3,280 feet elevation. Plants can reach nearly 100 percent cover over large areas inhibiting native plant seedling recruitment and survivorship. There is one documented occurrence of Italian plumeless thistle within the watershed along the Squaw Valley Road.
- **spotted knapweed (*Centaurea maculosa*)** is a biennial to short-lived perennial herb rated as highly invasive by Cal-IPC and List A by CDFA. Spotted knapweed is common below 6,200 feet in disturbed open sites such as grasslands, overgrazed rangelands, roadsides and logged areas. This species competes aggressively with other species and may produce up to 40,000 seeds per plant. There are two documented occurrences of spotted knapweed approximately two miles east of the watershed boundary.

- **yellow star thistle (*Centaurea solstitialis*)** is an annual herb that is currently invading twelve million acres across California. It is rated as highly invasive by Cal-IPC and List C by CDFA and is of very high concern on the Shasta Trinity NF. This species occurs within the Squaw Valley Creek Watershed, and is particularly locally abundant in old pastures at the McCloud River Club (Hesseldenz 2011 personal communication), as well as the larger Shasta-Trinity NF. Currently there are only two documented occurrences in the watershed, totaling over six acres of infestation, along the 38N11 roadside.
- **Canada thistle (*Cirsium arvense*)** is a perennial herb rated as moderately invasive by Cal-IPC and List B by CDFA. Canada thistle is common below 5,900 feet throughout California on a variety of soil types. Canada thistle invades prairies, riparian zones, and roadsides. Canada thistle is intolerant of shade and therefore colonizes well in recently burned or harvested areas where canopy shading is low. There are two occurrences of Canada thistle in hydroelectric diversion tunnel tailings along Hawkins Creek approximately three miles outside of the watershed boundary.
- **bull thistle (*Cirsium vulgare*)** is a biennial forb is considered to be moderately invasive. It is common below 6,300 feet elevation throughout California on disturbed sites, roadsides, coastal grasslands, wetlands, forest openings, or rangelands and pastures. Currently there are two documented occurrences of bull thistle in the watershed, totaling approximately six and a half (6.5) acres of infestation, along the Squaw Valley Road.
- **houndstongue (*Cynoglossum officinale*)** is a perennial herb rated as moderately invasive by Cal-IPC. It is found in open disturbed and often moist habitats in the Cascade Range growing on sandy or gravelly soil between 2,600 to 5,000 feet elevation. There are three documented occurrences of houndstongue within the watershed along the Squaw Valley and 38N11 roads.
- **dyer's woad (*Isatis tinctoria*)** is a perennial or biennial herb native to Europe. It is rated moderately invasive by Cal-IPC and List B by CDFA. Dyer's woad is considered highly invasive locally (Hesseldenz 2011 personal communication) and is a highly competitive plant that occurs in rangelands, croplands, and undisturbed natural areas. No documented occurrences of dyer's woad are within the analysis area but three occurrences exist within two (2) miles of the watershed boundary mainly along the McCloud Reservoir.
- **perennial pea (*Lathyrus latifolius*)** is a perennial herb that is not yet rated by Cal-IPC or CDFA. It can be found in disturbed areas, especially roadsides below 6,200 feet elevation. Perennial pea can form dense colonies that may exclude desirable vegetation. There are numerous occurrences of perennial pea within and adjacent to the watershed along the Squaw Valley Road.
- **American pokeweed (*Phytolacca americana*)** is a perennial herb that is not yet rated by Cal-IPC or CDFA. American pokeweed is common below 3,200 feet elevation in disturbed habitats, gardens, and roadsides. The nearest population of American pokeweed occurs over seven miles south of the watershed analysis area within the McCloud Bridge campground.
- **black locust (*Robinia pseudoacacia*)** is a deciduous tree rated as limited in its invasion by Cal-IPC. Black locust is common throughout California below 6,300 feet elevation. It establishes mainly along roadsides, riparian areas, and disturbed woodlands. One occurrence was incidentally found during a vegetation study at the confluence of Squaw Valley creek and the McCloud River (Pacific Gas & Electric 2008). Two occurrences of black locust exist within two miles of the watershed boundary dispersed along roadsides and

one large population is present at the Ah-Di-Nah campground in the Lower McCloud watershed.

- **Himalayan blackberry (*Rubus armeniacus*)** is a perennial plant rated as a highly invasive species by Cal-IPC. Himalayan blackberry is common below 5,200 feet elevation throughout California. Habitat types where it is found include wetlands and disturbed moist areas that are either manmade or natural. One occurrence, that was approximately one quarter (0.30) acres in size in 2008, is documented dispersed along the Squaw Valley Road. Several occurrences have also been identified within the nearby Ah-Di-Na campground area (USDA Forest Service 1998).
- **Spanish broom (*Spartium junceum*)** is a perennial shrub is rated as highly invasive by Cal-IPC. It is common in disturbed areas such as roadsides, pastures, eroding riverbanks and slopes; however, it may also invade undisturbed grasslands, coastal scrub and chaparral ecosystems. Currently there is one documented occurrence of Spanish broom in the analysis watershed along the Squaw Valley Road.

Additional weed species identified in the watershed identified from the 2007 and 2008 FERC reliscensing surveys include one population of Fuller's teasel (*Dipsacus fullonum*), several occurrences of tall fescue (*Festuca arundinacea*), pepperweed (*Lepidium heterophyllum*), and two populations of cutleaf blackberry (*Rubus laciniatus*). St. John's wort (*Hypericum perforatum*) and common mullein (*Verbascum thapsus*) are also present. Many noxious weeds establish or are spread along roads, trails or fuel-breaks via human or mechanical vectors. Several of these species may also colonize nearby off-road areas following a disturbance such as fire or logging (Bossard et al. 2000). This may be particularly true of species with high seed dispersal capabilities such as black locust (Landenberger et al. 2007), Canada thistle or bull thistle (Parendes and Jones 2000). It is well documented that invasive plant populations often establish or increase following fire events (Zouhar et al. 2008). Although this risk exists for applications of low-severity fires such as prescribed burning, a high-severity, large-scale, unplanned fire event would increase a risk of invasion significantly. As noted in the Fire and Fuels discussion, moderate or high intensity fires may remove overstory trees allowing for increased light as well as reduce soil nutrients; both of which are advantageous conditions within which invasive plants may out-compete natives in colonization or spread.

The Squaw Valley Creek Watershed contains approximately 147 miles of road (including designated Off Highway Vehicle (OHV) routes) and 21 miles of trail. Although recreation within the watershed is somewhat limited (see Access and Human Uses sections) there are old jeep trails and hiking trails present where noxious weeds occur or have the potential to occur and spread (Mount and Pickering, 2009). There are several campgrounds within a few miles of the watershed boundary that are infested with noxious weeds. Electric transmission lines exist within three miles of the watershed analysis area which also often have many noxious weed occurrences. Although the limited access into and within the watershed reduces the likelihood of spread or introduction of noxious weeds, the close proximity to prominent weed sources may still pose a threat for further forest infestation.

Wind, water and wildlife also transport weeds into, out of and within the watershed. Species such as Canada and bull thistle have achenes (seeds) with a downy pappus that may be transported by wind although this is often only within a few meters of the parent plant (Bossard et al. 2000). Tree of heaven seeds are also wind dispersed. Other species such as Spanish broom may have their seeds dispersed via rainwash or river transport. Wildlife also distributes species such as pokeweed and Himalayan blackberry via ingestion of their fleshy fruits.

As noted in the previous section, distribution and abundance data regarding noxious weeds in the watershed are greatly lacking. Further surveys and monitoring of these species and their habitat conditions are needed.

Current Weed Treatment Activities

Currently there are no invasive plant species removal projects within the watershed analysis area. Nearby projects consist of: 1) broom (*Cytisus scoparius*, *Genista monospessulana,* and *Spartium junceum*) eradication through a combination of hand cutting, pile and burn, and herbicide application in the Packer's Bay area and 2) Dyer's woad and yellow starthistle treatments at the McCloud Boat Ramp (begun in2005). Past attempts have been made to control these species in the watershed with little success. Plants were cut and piled, and the piles later burned. Monitoring indicated that the majority of plants re-sprouted from their base. Pokeweed (*Phytolacca americana*) removal has successfully taken place in a nearby recreation area (Bailey's Cove) approximately 20 miles south of the watershed boundary.

Additionally, at least two private landowners near the watershed, PG&E and the McCloud River Club, manage for invasive species occurring on their property. In the case of PG&E, invasive species eradication is conducted in compliance with relicensing conditions. These control measures include manual (e.g. pulling or cutting), mechanical (e.g. mowing or discing), chemical (e.g. herbicides), and biological (e.g. insect or pathogens) strategies.

Terrestrial Wildlife Species and Habitat

Methodology

Wildlife species were divided into three main categories for the purposes of this analysis. These include the following:

- Federally listed by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (1973) as threatened, endangered, proposed or candidate
- Forest Service Sensitive
- Other species of interest
    - Survey and Manage species
    - Neotropical migratory birds
    - Game species

Each of these categories and subcategories contain species that have a variety of habitat associations. Habitat descriptions and associations are described in more detail below. Various maps in Appendix C display the various wildlife habitats that occur in the Squaw Valley Creek Watershed Analysis area.

Current information for known locations of these wildlife species, Survey and Manage wildlife species, and species of interest occurring in the Squaw Valley Creek Watershed were assessed using district and corporate GIS data layers for species' locations. These data were compiled from past surveys, incidental sightings and known historical detections. In addition, data were gathered from the California Natural Diversity Database (CNDDB), Natural Resources Information Systems (NRIS), Forest Carnivore Surveys in the Pacific States database, and the USFWS website that provides lists of threatened, endangered, proposed or candidate species with the potential to occur in given geographic areas.

Habitat descriptions and conditions were analyzed using Existing Vegetation (EVEG) data (USDA Forest Service 2007) in conjunction with National Agriculture Imagery Program (NAIP) imagery and district vegetation GIS layers (see the project file). On-the-ground conditions were then assessed during field visits.

Federally Listed Species

Three federally listed terrestrial wildlife species are described within the USFWS list of species with the potential to occur within the watershed, based on potential habitat availability or a description of the species' range. In addition, two Candidate species were also listed as having potential to occur in the analysis area.

The analysis area is located within four USGS quads: Yellowjacket Mountain, Tombstone Mountain, Girard Ridge and Dunsmuir. The following species were listed as having either their current or historic range occurring within these quads.

- Northern spotted owl (*Strix occidentalis caurina*) - Threatened
- Calilfornia red-legged frog (*Rana draytonii*) - Threatened
- Vernal pool fairy shrimp (*Branchinecta lynchi*) - Threatened
- Pacific fisher (*Martes pennat*) – Candidate
- Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) - Candidate

Forest Service Sensitive Species

- Forest Service Sensitive terrestrial wildlife species known or expected to occur or with suitable habitat in the Squaw Valley Creek Watershed; based on either known location data or suitable habitat availability include the following species. An asterisk [*] denotes species also categorized as Survey and Manage species.
- Late-seral mixed-conifer habitat
    - Northern goshawk (*Accipter gentilis*)
    - Pacific fisher *(Martes pennanti pacifica)* (also Candidate species)
    - American marten(*Martes americana*)
    - California wolverine (*Gulo gulo luteus*) (also Candidate species)
    - Bald eagle (Haliaeetus leucocephalus)
- Early/mid-seral and oak woodland habitats
    - Pallid bat *(Antrozous pallidus)*
    - Townsend's big-eared bat (*Corynorhinus townsendii*)
    - Western red bat (*Lasiurus blossevillii)*
- Cave habitat
    - Pallid bat
    - Townsend's big-eared bat

- Riparian-associated species – terrestrial
    - Northwestern pond turtle (*Emys marmorata marmorata*; formerly *Clemmys marmorata marmorata*)
    - Foothill yellow-legged frog (*Rana boylii*)
    - Cascade frog (*Rana cascade*)
    - Southern torrent salamander *(Rhyacotriton variegatus*)
    - Willow flycatcher *(Empidonax trailii*)
- Limestone-associated species
    - Shasta salamander* (*Hydromantes shastae*)

Other Species of Interest

- Silver-haired bat (*Lasionycteris noctivagans*)(snags/crevices)
- Fringed myotis (*Myotis thysanodes*) (snags)
- Long-legged myotis (*Myotis volans*) (snags)
- Yuma myotis
- Long-eared myotis (*Myotis evotis*) (snags)

- Terrestrial Mollusks
    - Shasta hesperian snail* (*Vespericola shasta)*
    - Siskiyou sideband* (*Monadenia chaceana*)
    - Tehama chaparral snail* (*Trilobopsis tehamana)*

Survey and Manage Species

In 1994, the USDA Forest Service and USDI Bureau of Land Management adopted standards and guidelines for the management of habitat for late-successional old growth (LSOG) forest-associated species within the range of the northern spotted owl, commonly known as the Northwest Forest Plan (NWFP). The key elements of the NWFP are the system of reserves (with focus on maintenance of late-successional habitats), the Aquatic Conservation Strategy, and various standards and guidelines affecting each of seven different land allocations. Also, mitigation measures were included for management of about 400 rare and locally restricted species, collectively known as the "Survey and Manage" program. The Survey and Manage guidelines of the NWFP record of decision (ROD) provide an adaptive-management process for managing rare and uncommon, poorly understood old-growth-forest-associated species. The adaptive-management process is based on managing species and their habitats consistent with the most current scientific information, and utilizing a comprehensive program of information gathering, analysis, and interpretation to guide management actions while providing for the likelihood of persistence for LSOG forest-associated species (Molina et al. 2003).

The Squaw Valley Creek Watershed provides habitat for four terrestrial Survey and Manage wildlife species – three terrestrial mollusks and one amphibian. These species are also managed as FS Sensitive species as described above.

- Shasta salamander

- Shasta Hesperian snail
- Siskiyou sideband
- Tehama chaparral snail

Game Species

Various game species are known to occur in the watershed and are generally associated with the early seral brush habitats, as these areas tend to provide the most browse, forage and hiding cover. Game species present include deer, elk, turkey, black bear, mountain quail, western gray squirrel, band-tailed pigeon, and grouse.

Neotropical Migratory Birds

Neotropical migratory birds are associated with a wide variety of habitat types within the Squaw Valley Creek Watershed, including oak woodland, mid and late seral mixed conifer, riparian, open water, cliff and talus slopes, grassland, and chaparral/brush. These areas provide both potential breeding habitat and migration corridors for over 215 different species of birds.

Focal habitats within the watershed

Squaw Valley Creek Watershed contains multiple habitats of interest including large, contiguous blocks of late seral mixed conifer forest, mid seral transitional forests, riparian corridors, early seral brush fields, limestone outcroppings and caves. Each habitat contains a suite of species with strong associations to particular elements of that habitat as well as a dependence upon the existence of these elements in perpetuity. Habitats within the watershed are categorized into broad groups based on the relative abundance, uniqueness or potential sensitivity to management actions within the watershed.

In addition to these habitat types, there are also categories for management of the habitat based on either LRMP land allocation, as described in the sections above, or federally designated Critical Habitat. The Squaw Valley Creek Watershed contains large blocks of high quality northern spotted owl habitat which has been designated as Critical Habitat for the species by the USFWS (see Map 19).

Late seral mixed conifer habitat

Late seral (or late-successional) forests are generally characterized as older, multi-layered structurally complex forests with large diameter trees, high amounts of canopy cover, and decadence components such as broken-topped live trees, mistletoe, cavities, large snags, and fallen trees (USDA Forest Service 1999). These stands are relatively dense with large trees as well as a component of broad leaf trees and shrubs. Many of the larger trees contain rounded or flat tops, broken tops, conks, fire scars, and/or sparse live crowns. Crown closure is greater than 40 percent but averages 60-90 percent. Multi-storied stands are common. Some pockets of regeneration or shrubs occur within openings created by overstory tree mortality. At one time stands occupying the drier sites were more single storied but over the past 75-100 years white and red fir has established within the midstory of many of the older stands (USDA Forest Service 1999), while big leaf maple (*Acer macrophyllum*) and dogwood (*Cornus* sp.) tend to become established within the more moist sites. Within the understories of the more moist sites, such as Tom Neal Creek and Trough Creek, hazelnut and a number of other shade-loving shrubs are present, along with ferns, vines, and other groundcovers. The understories of drier sites are now fairly barren in some areas. Fuels management in these areas could result in the return of a lush understory.

For the purposes of querying the 2007 EVEG database, the following criteria were used to categorize habitat as late seral: WHR size class 5 (>24"dbh), Canopy Closure M (40 – 59 percent) or D (60-100 percent), and coniferous forest types of Sierran Mixed Conifer (majority of habitat), Douglas-fir, closed cone cypress (very small percentage), ponderosa pine – Douglas-fir (very small percentage), and white fir.

There are 11,104 acres (or 61 percent) of late seral mixed conifer habitat on federal lands within the watershed and 2,151 acres of this habitat on private land (or 19 percent) for a total of 13,255 acres within the watershed. This represents over 45 percent of the entire watershed, and does not include the mid seral, transitional habitats as described below. Tables 17-19 below display the conifer seral stages and canopy closures for coniferous forest types in the Squaw Valley Creek Watershed Analysis area in both private and federal lands (see Map 16).

Table 17. Seral stage and canopy cover for mixed conifer forests on private lands in the Squaw Valley Creek Watershed.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% Canopy) acres					% Per Size Class
		S (10-24%)	P (25-39%)	M (40-59%)	D (60-100%)	Total Acres	
1: < 1"	Early seral	0	0	0	0	0	0
2: 1"-6"		3	3	9	38	53	0
3: 6"-11"	Mid seral	9	54	242	1469	1775	16
4: 11"-24"		14	29	717	6665	7425	65
5: > 24"	Late seral	0	0	16	2135	2151	19
Total Acres of Conifer		26	86	983	10308	11403	100

Table 18. Seral stage and canopy cover for mixed conifer forests on public lands in the Squaw Valley Creek Watershed.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% Canopy) acres					% Per Size Class
		S (10-24%)	P (25-39%)	M (40-59%)	D (60-100%)	Total Acres	
1: < 1"	Early seral	0	0	0	0	0	0
2: 1"-6"		1	0	4	19	24	0
3: 6"-11"	Mid seral	0	8	9	1562	1579	9
4: 11"-24"		31	49	67	5229	5377	30
5: > 24"	Late seral	0	0	2	11102	11104	61
Total Acres of Conifer		33	57	82	17912	18084	100

Table 19. Conifer Types included in Tables 17 and 18.

WHR Type	WHR Name	GIS Acres	% WHR Type per Total Conifer
CPC	Closed-Cone Pine Cypress	57	0
DFR	Douglas-fir	385	2
PPN	Ponderosa Pine	30	0
SMC	Sierran Mixed Conifer	17,328	96
WFR	White fir	286	2
Total		18,084	100

Species associated with this habitat type can also use pockets or patches of other habitat types that may not consist primarily of conifer species and may have a strong hardwood presence, particularly black oaks or tanoak (referred to as montane-hardwood or montane-hardwood-conifer in the WHR classifications). These may be secondary habitats used for foraging or as connectivity patches. When late seral stage of these habitats (WHR size class 4 and 5) are factored in, there is an additional 4,950 acres of late seral habitat available.

Connectivity is a measure of the extent of which the landscape pattern of the late-successional and old-growth ecosystem provides for biological and ecological flows that sustain late-successional and old-growth associated animal and plant species across the range of the northern spotted owl (Thomas et al. 1990). The ability to move across the landscape is important to the long-term persistence and viability of many wildlife species, particularly late-successional habitat associated species such as forest carnivores, spotted owls, and goshawks. The ability for movement or dispersal of these species across the landscape is provided by large blocks of late-successional habitat, particularly in LSRs, and through management objectives and various land allocations within the LSR (USDA Forest Service 1999). Those land allocations and associated management objectives include: Riparian Reserves, administrative withdrawn areas, management prescriptions, retention of old-growth fragments in Matrix lands, and 100-acre LSRs (LRMP).

Mid seral habitat

Though many species that have been identified as being closely associated with late seral forests may also use mid seral stands, as primary or secondary habitat, levels of large snags and coarse woody debris (CWD) and complex vertical structure are generally at levels less than what typically occurs in late seral forests. Use of these areas may occur due to the higher levels of canopy closure and mix of large trees amongst the generally younger stand. Therefore, a distinction is made between mid and late seral forests as far as suitability to species associated with late seral habitat.

Mid seral habitat adjacent to later seral stands provides for connectivity between older, late seral stands and may serve to reduce the effect of fragmentation on late seral associated species and may serve as a protective buffer against predation by barred owls and great horned owls. Late seral dependent species may also occupy mid seral habitat as “outliers” (individuals found outside established territories). The mid seral habitat may serves as a transitional habitat for species and may be important in supporting these individuals until they are able to utilize the preferred late seral habitat. Mid seral habitat often contains areas of microhabitats that consist of either openings with more early seral vegetation or patches of older, more mature habitat, and subsequently can serve a wider variety of species overall until the stand matures and becomes more contiguous.

For the purposes of querying the 2007 EVEG database, the following criteria were used to categorize habitat as mid seral: WHR size class 4 (>11-24"dbh), Canopy Closure M (40 – 59 percent) or D (60-100 percent), and coniferous forest types of Sierran Mixed Conifer (majority of habitat), Douglas-fir, closed cone cypress (very small percentage), ponderosa pine-Douglas-fir (very small percentage), and white fir.

There are 5,296 acres (or 28 percent) of mid seral mixed conifer habitat on federal lands within the watershed and 7,382 acres of this habitat on private land (or 65 percent) for a total of 12,678 acres within the watershed. This represents approximately 43 percent of the entire watershed.

Early seral, browse and oak woodland habitat

Early seral habitat in the watershed is comprised of brush species such as manzanita, Brewer's oak (*Quercus garryana* var. *breweri*), deerbrush (*Ceanothus integerrimus*), and other shrub species. Terrestrial wildlife species in the area associated with this habitat type include deer, turkey and elk. The current condition of the brush/browse in the watershed is variable, depending much on soil type, aspect, slope and disturbance regime. The few areas that have burned in past wildfires contain a mosaic of new growth and older brush skeletons or young, dense pine regeneration. Many areas of early seral vegetation in the watershed contain older, decadent brush with much reduced palatability as browse.

There is a very small amount of early seral stage coniferous forest on the federal lands in the watershed, likely due to the lack of a significant disturbance regime or timber harvest activities. Table 20 describes the WHR habitat types that represent early seral habitat in the Squaw Valley Creek Watershed. These categories best represent vegetation types that exist in the watershed that would be suited for species associated with early seral habitat.

Brush, browse, and oak woodland occur in the watershed in small quantities as demonstrated in the tables below. As shown in Table 20, very little oak woodland exists within the watershed, with the majority occurring on federal lands in the southern and southwestern portion of the watershed. These areas contain a mix of canyon live oak and black oak, in combination with brush species including Brewer's oak and shrub tanoak (*Lithocarpus densiflorus*).

Table 20. Brush/browse habitat and hardwood/oak woodland as represented within the Squaw Valley Creek Watershed.

Habitat Type (WHR Type)	Private land - acres	Percentage of private land in watershed	Public land - acres	Percentage public land in watershed
Mixed Chaparral (MCH) - Browse habitat	14	0	503	2
Montane Chaparral (MCP) - Browse habitat	169	1	367	2
Montane Hardwood-Conifer (MHC) - Oak woodland/conifer mix: all size classes	1582	11	2588	11
Montane Hardwood (MHW) Oak woodland: all size classes	178	1	1500	7

Table 21. Conifer and Hardwood Acres (and mixed) and early seral vegetation types compared to all acres in watershed on private lands.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% Canopy)				Total Acres	% Per Size Class
		S (10-24%)	P (25-39%)	M (40-59%)	D (60-100%)		
Grass; Barren; Lacustrine, etc.	Early seral (conifer and hardwood combined)	Density class not applicable (grass, barren, etc.)				907	6
Brush (MCP and MCH); size = X or 0		Density class not applicable to brush				288	2
1: < 1"		0	4	0	2	6	0
2: 1"-6"		3	3	14.08	78	98	1

Table 22. Conifer and Hardwood Acres (and mixed) and early seral vegetation types compared to all acres in watershed on public lands.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% Canopy)				Total Acres	% Per Size Class
		S (10-24%)	P (25-39%)	M (40-59%)	D (60-100%)		
Grass; Barren; Lacustrine, etc.	Early seral (conifer and hardwood combined)	Density class not applicable (grass, barren, etc.)				24	0
Brush (MCP and MCH); size = X or 0		Density class not applicable to brush				872	4
1: < 1"		0	0	0	0	0	0
2: 1"-6"		3	2	10	128	142	1

Other habitats present in the watershed

Other habitat types present in the watershed, although comprising a smaller proportion of the watershed than those discussed above, include riparian corridors, grasslands, and limestone outcrops and caves. Each of these habitat types is utilized by a particular mix of associated wildlife species. The overall availability of each of these habitat types is limited within the watershed, but the quality remains relatively high within the public lands as very little activity, as far as timber harvest or other disturbance, has occurred in these areas. Private lands have had a variety of activities, some of which have degraded some habitats, (e.g. timber harvest and grazing within the riparian corridors and grasslands) and impacted the vegetation and the subsequent suitability of the habitat within these areas.

Habitats such as limestone outcroppings, caves, and riparian corridors do not lend themselves to management practices such as mechanical fuels treatments or thinning as a means of protection or maintenance. These areas are less susceptible to severe fire events and tend to be more able to recuperate if impacted by fire. Also, fires tend to react less severely when they do occur, as these areas tend to be more moist and humid and less capable of carrying fire. Therefore, the general practice of avoidance during management activities and avoidance of disturbance, particularly mechanical but also from livestock, is considered sufficient for the maintenance and protection of these habitats and the species with the potential to occur within them.

Limestone caves are uniquely vulnerable to impacts from recreational caving. Traditional concerns have focused on intentional and unintentional damage to cave formations and physical disturbance of hibernating bats. Recently, however, a new threat has emerged in the form a bat fungal disease (*Geomyces destructans*), commonly called White-Nose Syndrome (WNS), which is carried from cave to cave on the dirty shoes, clothing, and caving equipment. WNS-infected bats use up their vital fat reserves during hibernation and end die of starvation. WHS started in the Eastern U.S. and has not yet been documented in Western caves, but researchers fear that it is only a matter of time.

Critical Habitat (NSO)

The intent of critical habitat for the northern spotted owl is to provide the physical and biological features that were the basis for determining the habitat to be critical. Those physical or biological features are referred to as ‘Primary Constituent Elements’ and include, but are not limited to:

- Space for individual and population growth, and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal;
- Habitat that is protected from disturbance and/or representative of the historic, geographical, and ecological distributions of a species

The Primary Constituent Elements for northern spotted owl critical habitat include:

- Forests which provide nesting, roosting, or foraging habitat, including stands which currently provide foraging habitat for resident spotted owls, even if the stand may not currently provide nesting conditions.
- Forest stands with adequate tree size and canopy cover to provide some protection from avian predators and at least minimal foraging opportunities. It is important to note some dispersal habitat may not provide nesting, roosting, or foraging habitat, though nesting, roosting, and foraging habitat will provide for dispersal.
- Lands that have the potential to produce nesting, roosting, foraging, or dispersal habitat sometime in the future, though not currently in such a habitat condition;

Critical habitat within the Squaw Valley Creek Watershed includes portions of Critical Habitat Unit (CHU) #CA-4/CHU 28 (Eastern Klamath Mountains) Subunit 77, which was seen by the Interagency Scientific Committee (ISC) as the best opportunity to create a large habitat conservation area in the Shasta-McCloud subprovince (see Map 19). This CHU is one of the keys to maintaining the viability of the subprovince and providing a source population, and is considered in the LSR Assessment as one of the most important CHUs to protect in the subprovince. It is also a vital area for providing linkage and an opportunity for genetic interchange between the northern and California subspecies (USDA Forest Service 1999).

Terrestrial Wildlife Species within the Watershed

Federally Listed

Northern spotted owl

The northern spotted owl (NSO) is a medium-sized owl that inhabits conifer forests of the Pacific Northwest, including northwestern California (Forsman et al. 1984). These owls occupy large home ranges (>3,000 acres). Because this species exhibits strong affinities for mature and old-growth forests and can incorporate large tracts (985 acres) of these forests into its home range, mature and old-growth coniferous forest has been considered equivalent to northern spotted owl habitat (Franklin et al. 2000).

Northern spotted owls are strongly associated with late seral coniferous forests. Suitable habitat for the species on the Shasta Trinity NF is described as multi-layered, multi-species coniferous forest stands with >60 percent total canopy cover for nesting/roosting, a minimum of 40 percent canopy cover for foraging; large (>18"dbh) overstory trees, large amounts of down woody debris, presence of trees with defects or other signs of decadence in the stand (USDI 2011). This forest type is a subset of suitable habitat and may vary due to climatic gradients across the range (USDI 2011).

Determinations of suitability also consider size of stand and adjacency to other habitat types, which owls can utilize. Forested stands with reduced acreage due to past land management activities or natural occurrences such as wildfire can create limiting habitat attributes essential to individual owl viability. Wildfire can potentially limit foraging resources, as well as predator protection and thermal protection. These foraging resources include prey abundance and essential cover for protection during foraging endeavors; and can both be depreciated or lost when intense wildfire moves through a forested stand.

Currently there are four NSO activity centers in the Squaw Valley Creek Watershed: ST-207, ST-208, ST-212, and ST-220 (Table 23). Suitable habitat exists throughout the watershed in the form of large areas of late seral mixed coniferous forest, as described in the tables and discussion of late seral habitat above.

Table 23. Northern spotted owl activity centers in the Squaw Valley Creek Watershed as of 2010.

NSO Activity Center ID	Year established	Year last visited	Site Status	Reproductive Status
ST – 207	1989	2003	Active	Nesting
ST – 208	1989	2009	Active	Night Response
ST – 212	1989	2004	Active	Non-nesting pair
ST – 220	1991	1995	Active	Nesting

Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp is a federally listed crustacean endemic to California and Oregon vernal pools. It inhabits small vernal pools with cool water (10ºC) of moderate alkalinity and conductivity that are less than 1m deep. Vernal pools are defined as temporary wetlands that form in depressions of unplowed grasslands over a hardpan clay layer. Pools fill with winter rains and evaporate over time, lasting anywhere from a few weeks to a few months (Gallagher 1996). As a result, this species completes its life cycle in a matter of weeks.

The current distribution of the vernal pool fairy shrimp is limited to Oregon and California. Populations are found in Southern Oregon's Agate Desert and in California's Central Valley and coastal mountains. Just three occurrences are also found in Southern California. Relative to other fairy shrimp, this species has a relatively large distribution; however, it is uncommon within its range. Historic data are nonexistent since it was first described in 1990. Its distribution or abundance may have been much greater in the past, since vernal pools are currently an endangered habitat. California's Central Valley has lost 75 percent of its vernal pool habitat and Oregon's Agate Desert has lost 90 percent (Gallagher 1996).

The presence of a hardpan layer in the Squaw Valley Creek Watershed is unknown at this time. There have been no surveys conducted in the area for either vernal pools or vernal pool fairy shrimp. The lack of specific knowledge about vernal pools in the area is likely due to the general lack of access and subsequent lack of management activities in the area. If vernal pools do exist in the area, they are likely intact due to a lack of a disturbance mechanism, and potentially serve as habitat for species associated with this habitat type. If management actions are proposed for this area, an assessment of the potential for vernal pools would help to provide locations to be avoided during ground disturbing activities.

California red-legged frog

The historic range for the California red-legged frog includes Shasta and Siskiyou County but the current range described by the USFWS shows no occurrences within the watershed or these counties. Siskiyou and Shasta County, including the Squaw Valley Creek Watershed, were included in the original designation of critical habitat for the California red-legged frog. However, critical habitat for this species was revised and became effective as of April 16, 2010. The newly revised designated critical habitat no longer includes Shasta and Siskiyou County within the designation. In the declaration within the federal register, the USFWS stated that the areas removed from the 2001 designated critical habitat did not contain essential habitat features or were not essential to the conservation of the species. Therefore, while the current designation does not include all areas where red legged frogs have occurred, is does "more precisely map the essential physical and biological features that occur within the geographical area occupied by the California red-legged frog at the time of listing, and includes those areas containing the most suitable habitat for use by the frog"(USDI 2010).

The California red-legged frog is the largest native frog in the western United States. It is endemic to California and Baja California, Mexico, at elevations ranging from sea level to approximately 5,000 feet. It uses a variety of areas, including aquatic, riparian, and upland habitats, but certain habitat features are critical; the most important feature being a pond, a slow-flowing stream reach or a deep pool within a stream that contains vegetation to which an egg mass can be attached. In addition, these areas must hold water long enough for tadpoles to complete their metamorphosis into juvenile frogs that can survive outside of water (USDI 2010). This habitat type does exist in the watershed, though there are no known occurrences of this species in the area and it is outside of the current range of this species.

Forest Service Sensitive

Bald Eagle

The bald eagle was listed in 1967 under legislation that preceded the Endangered Species Act, and was officially listed as Endangered when the Act was signed into law in 1973. The bald eagle was listed as Endangered in the lower 48 states of the United States because of a severe decline in numbers. This decline was primarily attributed to the use of certain pesticides that caused reproductive dysfunction and eggshell thinning. Habitat loss and disturbance at nest and roost sites were also major factors. Eagle populations have rebounded since the banning of DDT and the increased protection for nesting and winter roosting habitat. The bald eagle was removed from the Endangered Species List by the USFWS on July 9, 2007 and is now managed as a FS Sensitive Species. Viability of this species on the Forest is expected to be provided through implementation of the National Bald Eagle Management Guidelines (USDI 2007) the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act and implementation of LRMP standards and guides for bald eagles.

Nesting territories are generally associated with lakes, reservoirs, rivers or large streams. Nest trees are generally large-limbed, mature overstory conifers (generally pine) located within close proximity (2 miles or less) to large bodies of water that provide fish and water fowl for foraging. Bald eagles have a very high fidelity to their established nests. A pair will remain in the same nest area year after year if left undisturbed.

Bald eagles are known to occur in the watershed and have been seen along Squaw Valley Creek during spring and summer months. Habitat for nesting and foraging exists along Squaw Valley Creek. An active nest was discovered in the late 1990's approximately ½ mile upriver from the mouth of Chatterdown Creek on the former Bollibokka Club, and has continued to remain active (Hesseldenz 2011 personal communication). Other nests may also exist within the watershed, though no others have been documented.

Northern Goshawk

Northern goshawks can be found in middle and higher elevation mature coniferous forests; usually with little understory vegetation and flat or moderately sloping terrain. Moderate and high quality habitats contain abundant large snags and large logs for prey habitat and plucking posts (Squires and Reynolds 1997). Goshawks generally breed in mature coniferous, mixed, and deciduous forest habitats. Suitable nesting habitat contains large trees for nesting, a closed canopy for protection and thermal cover, and open spaces allowing maneuverability below the canopy (Squires and Reynolds 1997). Territories associated with large contiguous forest patches are more consistently occupied compared to highly fragmented stands.

On the Shasta-Trinity NF, goshawk habitat consists of mid- and late-successional mixed conifer forest with scattered harvested and natural openings. Foraging habitat is variable and includes mid- and late-successional forest, natural and man-made openings, and forest edges.

There are no known northern goshawk territories in the Squaw Valley Creek Watershed. Very few goshawk surveys have been conducted in the watershed and none recently. Suitable nesting and foraging habitat exists throughout the area and nests are likely present in the late seral and mid seral habitat described in the tables above.

Pacific Fisher

The fisher is a forest carnivore that occupies late seral stage habitat in mature and old growth mixed conifer stands with a home range that can be very large (up to 11,000 acres in low quality habitat) (CDFG 2010). In the western mountains, fishers prefer late-successional forests (especially for resting and denning) and occur most frequently where these forests have the fewest non-forested openings. Historically, trapping for fur reduced fisher populations.

Drainage bottoms are generally used more often for resting compared to ridge-tops and mid-slope locations possibly due to increased access to water, increased prey abundance, larger trees, and denser canopy cover (Yeager 2005). Riparian areas provide concentrations of rest site elements, such as broken-top trees, snags, and coarse woody debris. Whether for prey availability, water access, riparian vegetation or microhabitat conditions, fisher may selectively use rest sites within 500 feet of water, and rarely farther than 1,100 feet from water. Fisher tend to use large live trees with cavities, particularly oak species, and logs for rest structures.

Populations of fisher currently occur in the North Coast Ranges of California and the Klamath-Siskiyou Mountains of northern California and southern Oregon. Additionally, surveys and sightings in California place fisher throughout much of the Sierra Nevada range. There are over 50 sightings of fisher in Siskiyou and Shasta County in the CNDDB database (CNDDB 2011) dating back to 1940 and 43 sightings recorded in the Forest Carnivore Surveys in the Pacific States database. One sighting was directly within the watershed (located by Redwood Sciences Lab), seven sightings were approximately 12 miles north of the watershed, and five were approximately 5 miles to the west of the watershed. Habitat for fisher exists in the watershed and based on the recorded sightings and the juxtaposition of additional sightings, it is likely that the area presently supports a fisher population, though the size and distribution of which is currently unknown.

American Marten

American marten tend to use high elevation (generally >5,000 feet), multi-storied, late-successional mixed conifer forests with moderate to dense canopy closure. Preferred habitat consists of a dense overstory exceeding 70 percent with an average minimum tree size >24”dbh and sufficient understory particularly larger quantities of slash, rotten logs and stumps to provide hiding cover and denning areas. In most studies of habitat use, martens were found to prefer late-successional stands of mesic coniferous forest, especially those with complex physical structure near the ground (Buskirk and Powell 1994). This complex physical structure near the ground addresses three important life needs of martens: it provides protection from predators, access to the subnivean space where most prey are captured in winter, and protective thermal microenvironments, especially in winter (Buskirk and Powell 1994). Therefore, martens are most limited to the narrowest range of habitats within their home ranges during the winter months. Martens gain access to subnivean spaces created by coarse woody debris at lower snow depths, and by lower branches of live trees in deep snow (Corn and Raphael 1992). In general, these subnivean access points have higher volumes of coarse woody debris, more log layers, and fewer logs in advanced stages of decay.

Removal of coarse (large) woody debris from forests or interfering with processes that make it available in suitable sizes and stages of decay by removing standing trees and snags may indirectly affect martens by reducing habitat quality.

Martens generally occupy stands that are located within ¼ mile from water with forest openings less than one acre in size. They are most abundant in forested areas adjacent to meadows or riparian corridors, but use travel ways comprised of closed canopy forests to move between foraging areas. Martens generally avoid habitats that lack overhead cover, and tend to avoid crossing large openings (> 300 yards), especially in winter. However, when they do use or cross these areas, they tend to focus on coarse (large) woody debris, low growing branches, or patches of shrub.

Several aspects of marten life history predispose it to being affected by human activities including: its habitat specialization for mesic, structurally complex forests; its low population densities; and its low reproductive rate for a mammal of its size (Ruggiero et al. 1994).

Marten sightings have been documented in the Shasta-McCloud Management Unit. Private land surveys were completed in 1990-1995 on the McCloud Flats (east of the watershed) and in the

Sacramento River Canyon area, (west of the watershed) (Criss and Kerns 1990). Marten were documented at the higher elevations, 4,000 feet and above. In the Forest Carnivore Surveys in the Pacific States database, there are three sighting for marten north of the town of McCloud, approximately 13 miles north of the watershed boundary. In 2002-2003 surveys were conducted on the Shasta-McCloud Management Unit along routes within the Pilgrim Creek Snowmobile Park. Marten were detected at various camera locations at the higher elevations (4,000-7,000 feet) during three survey periods. No sightings for marten were recorded in the CNDDB database in the vicinity of the Squaw Valley Creek Watershed.

California wolverine

Wolverines are generally considered a solitary species, with adults associating only during the breeding season. The species occurs at low densities and is highly secretive, making estimation of population trends difficult (Banci 1994). Wolverine home ranges are generally extremely large, with adult ranges up to 350 square miles (Banci 1994). The current range in the contiguous United States is believed to include Idaho, Montana, Oregon, Washington, Wyoming, and California (Banci 1994). Wolverines are highly dependent upon mature, late-successional conifer forests for survival in winter, and generally move downslope in winter into heavier timber where food is available (Zeiner et al. 1990). They also use red fir, subalpine conifer, alpine dwarf-shrub, lodgepole, wet meadow, Jeffrey pine and montane riparian habitats.

Wolverines naturally occur in low densities (Zeiner et al. 1990). They are difficult and expensive to study and are rarely observed, so a lack of sightings does not necessarily mean that wolverines are not present. There have been few surveys of wolverines in the contiguous United States that were designed to estimate population size at even a local scale.

Historical trapping reduced populations in various parts of the United States range, including California. Limiting factors for this species include habitat fragmentation and human disturbance, which have prevented population recovery since the days of trapping.

Habitat exists in the Squaw Valley Creek Watershed for this species in the form of large tracts of contiguous late seral habitat. In addition, there are also relatively few roads and subsequently low levels of human disturbance. The possibility that wolverine are occupying the area exists, though only one wolverine has been recorded in the entire state of California in the last 20 years, despite hundreds of days of forest carnivore surveys across northern California (Moriarty 2008). There are two sightings recorded in the watershed for California wolverine on Nature Conservancy lands during the 1980's (Hesseldenz 2010 personal communication), though neither sighting can be confirmed.

FS Sensitive Bats

A wide range of habitats are required by the various bat species present in the watershed. The FS Sensitive Townsend's big-eared bat, pallid bat and western red bat can utilize multiple different habitats in a given day. Suitable habitat for each of these species occurs in the watershed.

Pallid bats are usually found in low to middle elevation habitats below 6,000 feet. Varieties of habitats are used, including grasslands, shrublands, woodlands, and coniferous forests. Pallid bats most often occur in open, dry habitats that contain rocky areas for roosting. They are a yearlong resident in most of their range and hibernate in winter near their summer roost. Day roosts may vary but are commonly found in rock crevices, tree hollows, mines, caves and a variety of human-made structures. Tree roosting has been documented in large conifer snags, inside basal hollows of redwoods and giant sequoias, and bole cavities in oaks (Pierson and Rainey 2007). Cavities in broken branches of black oak are very important and there is a strong association with black oak for roosting. The site must protect bats from high temperatures, as this species is intolerant of roosts in excess of 104 degrees Fahrenheit. Night roosts are usually more open sites and may include open buildings, porches, mines, caves, and under bridges (Pierson and Rainey 2007). Pallid bats are very sensitive to roost site disturbance.

Townsend's big-eared bats are distributed broadly throughout western North America. They also occur in two disjunct, isolated populations in the central and eastern United States. In the West, this species' range extends from the Pacific coast north to southern British Columbia, south to central and southern Mexico and the Baja Peninsula (Gruver 2006). This species is found throughout California from low desert to mid-elevation montane habitats. The roost sites for this species are cavernous sites associated with caves, mines and buildings. It also roosts in hollow trees and certain types of bridges. The Townsend's big-eared bat has been documented in the Sacramento watershed and a roost is known to exist in a cave to the northeast of the Pit Arm watershed.

Western red bats are locally common in some areas of California; occurring from Shasta County to the Mexican border, west of the Sierra Nevada/Cascade crest and deserts (Zeiner et al. 1990). Red bat winter range includes western lowlands and coastal regions south of San Francisco Bay. The western red bat is typically solitary, roosting primarily in the foliage of trees or shrubs (Bolster 2005). Day roosts are commonly in edge habitats adjacent to streams or open fields, in orchards, and sometimes in urban areas. Red bats require water and there may be an association with intact riparian habitat, particularly willows, cottonwoods, and sycamores. In 1997, the Shasta-Trinity NF began surveys in areas where proposed activities could affect potential roost sites. During the course of a six year survey period (June through September 2005-2010) with over 80 nights of bat mist net monitoring at the Trout Creek watershed area, two red bats were found. Both bats were captured in late August during migration. There are no known locations of western red bat roost sites in the Squaw Valley Creek Watershed, though habitat exists.

Terrestrial Riparian-Associated Wildlife Species

Northwestern pond turtle

Northwestern pond turtles are associated with permanent or nearly permanent water from sea level to 6,000 feet in elevation. Western pond turtles (species *Emys marmorata-* formerly known as *Clemmys marmorata;* Spinks et al. 2003) can be found in the United States from Washington to Baja, California, though the subspecies, the northwestern pond turtle, is only found in Washington through northern California, including some aquatic habitats on the Shasta-Trinity NF and the Squaw Valley Creek Watershed.

Northwestern pond turtles prefer the quiet stretches of moving water on ponds, lakes, major rivers and streams. Important habitat elements such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks, are used as basking sites and refuge from predators. Nest sites generally occur within ¼ mile of water sources, and are usually characterized as open areas dominated by grasses and herbaceous annuals with a southern exposure (Holland 1991).Causes of population decline include habitat loss and alteration (both aquatic sites used for feeding and basking, and nest sites), population fragmentation, predation on young, especially by raccoons and introduced predators (e.g. bullfrog), and commercial harvest for the pet trade. A local problem within the analysis area is that Northwestern pond turtles are occasionally run-over by cars on Squaw Valley Road in the spring (usually in May) when they are moving between Squaw Valley Creek and over-wintering sites and nest sites (Hesseldenz 2011 personal communication).

Distribution and abundance of northwestern pond turtles on the Forest and within the watershed is not well known due to a lack of survey information. Data records from the district include sightings within the watershed and there have been multiple sightings near Squaw Valley Creek, its tributaries and along the Squaw Valley Creek road (Hesseldenz 2011 personal communication). No systematic, structured surveys have been conducted directly within the Squaw Valley Creek watershed, though surveys were conducted in the adjacent Lower McCloud watershed as part of the FERC relicensing process for that watershed and detections were made. Habitat exists for this species throughout the watershed and it is likely that the area supports a population of northwestern pond turtles based on the juxtaposition of sightings in adjacent watersheds, abundant habitat, and the current sightings of individuals in the watershed, though the size and distribution of which is currently unknown.

Foothill yellow-legged frog

Historic distributions of this species ranged through most Pacific drainages west of the Sierra/Cascade Crest, from southern Oregon to southern California. Current distribution and abundance of this species has been reduced drastically in the southern portion of its range but it still occurs throughout coastal drainages in the northern portion of its range. This species is closely associated with permanent bodies of still water and are typically found at elevations below 1,800 feet. Breeding occurs in the spring, in shallow, slow flowing water with pebble and cobble substrate, preferably with shaded riffles and pools. It is also known to occasionally use moderately vegetated backwaters, isolated pools, and slow moving rivers with mud substrates.

The foothill yellow-legged frog is at risk due to various anthropogenic and environmental threats throughout its range. Among some of the larger rivers in California, predation from introduced bullfrogs has been implicated as a cause of their decline. In addition, increased sediment loads in breeding streams have a potential to reduce survival of eggs.

No formal surveys have been conducted in the watershed except for a small tributary to Squaw Valley Creek that was surveyed as part of the McCloud-Pit FERC relicensing process which resulted in no detections. Habitat for this species is present in the watershed along intermittent and perennial streams, though no detection information was found in district records or the CNDDB database.

Cascade frog

The Cascade frog is a montane species found in the Olympic Peninsula, Washington, and in the Cascade Range of Oregon, Washington, and northern California (Blaustein et al.1995). Populations appear to be declining throughout the range. Reasons for this decline are not well understood, but locally populations have been impacted by predation from introduced, non-native aquatic species.

Habitat for this species includes montane meadows, marshes, ponds, small bodies of water, ephemeral pools, potholes without vegetation, and along small creeks. They are typically found at elevations above 2,500 feet and are closely restricted to water. Habitat for this species exists throughout the watershed. No formal surveys have been conducted within the watershed, though a small tributary to Squaw Valley Creek was surveyed as part of the McCloud-Pit FERC relicensing process and resulted in no detections.

Southern torrent salamander

This species occurs from northwestern California to the Coast Range of Oregon in mid to low elevations. Habitat elements considered critical for survival include riparian vegetation, cool water present year round, and stream shade and water present for all stages of their life cycle. They are often associated with cold mountain streams, springs, and/or seepages that are well shaded and are no more than a few feet from free-running water. Declines of torrent salamanders have been attributed to increased amounts of sediments and increased water temperatures as a result of timber harvesting within their preferred habitat. Changes in forest canopies and the hydrology of seeps and streams can have negative impacts to southern torrent salamanders.

Management of Riparian Reserves through the Aquatic Conservation Strategy is expected to provide for or minimize impacts to aquatic and riparian associated species, including this species. While systematic surveys specific to this species have not been conducted within the watershed, personnel responsible for past stream and wetland surveys have looked for this species. In addition, a small tributary to Squaw Valley Creek that was surveyed as part of the McCloud-Pit FERC relicensing process which resulted in no detections. According to district records and CNDDB database, no detections have been made directly within the Squaw Valley Creek Watershed.

Willow Flycatcher

The willow flycatcher is a common migratory species that breeds in a variety of riparian shrub habitat from Maine to British Columbia and as far south as southern Arizona and California (Sedgwick 2000). In general, the willow flycatcher prefers moist, shrubby areas, often with standing or running water. In northern California, they are strongly tied to thickets of willows, whether along streams in broad valleys, in canyon bottoms, around mountain side seepages, or at the margins of ponds and lakes. Willow flycatchers have been recorded in the northern portion of the watershed in the riparian areas on private land and directly adjacent national forest land. Because the watershed does not contain many large patches willow that this species is strongly linked to, habitat for this species is fairly limited in the watershed. Potential exists for this species to inhabit several additional large patches of willow on the private land where Squaw Valley Creek transitions from a meadow stream to a canyon stream near the northern end of the watershed.

Terrestrial mollusks

- Shasta hesperian snail (*Vespericola shasta)*
- Siskiyou sideband (*Monadenia chaceana)*
- Tehama chaparral snail (*Trilobopsis tehamana)*

The Shasta hesperian snail is endemic to the Klamath Province, primarily in the vicinity of Shasta Lake, up to 2,700 feet elevation. It has been found in moist bottom lands, such as riparian zones, springs, seeps, marshes, and in the mouths of caves (Kelley et al. 1999). The Siskiyou sideband is known from Siskiyou County, though its range may extend to Jackson and Josephine Counties in Oregon. Its habitat includes the lower reaches of major drainages, talus and rock slides, under rocks and woody debris in moist conifer forests, caves, and shrubby areas in riparian corridors. Rocks and large woody debris may serve as refugia during the summer and late winter seasons (Kelley et al. 1999). The Tehama chaparral snail is an endemic species of Tehama, Butte, and Siskiyou Counties. This species is usually associated with rocky talus, but has also been found under leaf litter and woody debris on the ground within 300 feet of limestone outcrops (Kelley et al. 1999).

Multiple protocol surveys have been conducted in the Mount Shasta McCloud Management Unit since the designation of these species within the Northwest Forest Plan, though only a few have been conducted specifically within the Squaw Valley Creek Watershed, in most part due to a lack of management activities in the area. Protocol surveys were conducted in 180 acres along the eastern edge of the watershed along the Bald Mountain Jeep trail area from 2001 to 2002 and no target mollusk species were found. Neither the Siskiyou sideband snail nor the Tehama chaparral snail has been found during any of the protocol surveys on the Shasta-Trinity NF.

Limestone Associated Wildlife Species

Shasta salamander

The Shasta salamander is listed as both a FS Sensitive species and a Survey and Manage species. It primarily inhabits isolated limestone formations near Shasta Lake and surrounding area, though recent surveys have confirmed that it may also inhabit non-limestone habitats near the McCloud Reservoir. Currently, there are 61 known sites representing 16 to 17 population centers, most of which are on national forest land surrounding Shasta Lake (Naumann and Olson 2004). Habitat includes moist limestone fissures and caves, volcanic and other rock outcroppings, and under woody debris and duff in mixed pine-hardwood stands found near moist caves, rock cracks, and cliff faces (Gorman and Camp 1953).

A survey protocol and management plan has been developed for this species on the Shasta-Trinity NF. It is regularly surveyed for as part of the assessment process prior to ground disturbing activities. Primary threats listed in California Department of Fish and Game (CDFG) non-game species assessments include increased recreation around Shasta Lake, limestone quarrying, and raising of lake water levels. Recreational caving can also threaten populations in caves, since they are often out in the open and can easily be stepped on. In addition, timber harvest can cause a loss of habitat and possible direct mortality, due to moisture loss via canopy reduction and ground disturbance. Highways can act as barriers to dispersal, and rock quarries can remove or disrupt habitat.

Habitat exists for the Shasta salamander in pockets of limestone rock outcrops and caves scattered throughout the watershed. There are anecdotal, undocumented sightings of this species within a cave near Tombstone Mountain (Hesseldenz 2011 personal communication), though protocol surveys in this area have not been conducted.

Game Species

The herd of Colombian black-tailed deer that occupy the watershed is designated as the McCloud Flats deer herd by CDFG. The Weaverville deer herd utilizes the area to the west and south of the watershed, and the Cow Creek deer herd is to the east and south (see Map 31 – CDF&G Deer Range).

A management plan for the McCloud Flats Deer Herd was established in 1983 by the California Dept. of Fish and Game, Region I in cooperation with U.S. Forest Service, U.S. Bureau of Land Management and the National Park Service. This plan indicates the population trends, suitable fawning habitat, and management for critical winter and summer range. There is no designated critical winter range, fawning grounds, fall holding areas, or critical summer range for deer within the watershed (CDFG 1983 and GIS layers from CDFG). The adjacent watershed (Lower McCloud) contains some critical winter range in the southern portion, and there is also potential winter range to the north of the watershed. There is also long strip of critical winter range west of the I-5 highway, approximately five miles west of the Squaw Valley Creek Watershed.

Though there is limited knowledge regarding the area due to a lack of access, concerns exist for resident and seasonal deer populations, including the loss of early seral habitat, the loss of herbaceous and young shrub layer in the understory, and the loss of mast producing hardwoods. The exclusion of fire has caused the habitat to shift from a mosaic of early seral habitat, to mostly late seral habitat. This shift encroaches upon herbaceous openings as well as limits the amount of palatable browse. Fire exclusion has also allowed the understory of forested conifer and oak habitats to mature, to be shaded out and to be replaced by shade tolerant species. Late summer forage important for resident deer is reduced with this change in vegetation. Fire suppression has also allowed hardwoods within mixed hardwood/conifer habitats to be overgrown and shaded out. This is suspected to occur once the conifers reach >60 percent canopy. The mast produced by these hardwoods is reduced or eliminated, causing a reduction in an important food source for deer and other game species such as elk and turkey. Specific areas where these changes have occurred are unknown, though they are suspected to occur throughout the watershed (USDA Forest Service 1998). Changes can be determined by comparing the 1944 photos to current conditions (see Vegetation discussion in Chapter 4).

Fifty-one Rocky Mountain elk were introduced to the area in 1911 from Yellowstone National Park into the Squaw Creek drainage (south of the Squaw Valley Creek Watershed). Consequently, herds of over 80 animals now range over the eastern portion of the Whiskeytown Shasta-Trinity National Recreation Area (NRA) during all seasons, though they tend to extend into the higher elevations to the north and east of Shasta Lake, including the Squaw Valley Creek Watershed, during the summer months.

Elk are known to occupy the watershed, with some areas of concentrated use to the south and east of Squaw Valley Creek (Hesseldenz 2010 personal communication). Little, though, is known about the habitat's capability for elk and the overall extent to which elk are using the watershed. The Squaw Valley Creek Watershed may provide particularly appealing habitat for elk due the relative lack of roads and subsequent lack of access and human disturbance.

Black bears are common within the watershed during all seasons. They forage on a diversity of grasses, berries, forbs, browse, insects, and carrion. Road density and disturbance play a major role in habitat use and distribution of black bear. The Squaw Valley Creek Watershed may also provide particularly appealing habitat for black bear due to the relative lack of roads and subsequent lack of access and human disturbance.

Within hardwood stands, herbaceous forage and acorn production are important to many wildlife species, especially game species such as squirrels, turkey, bear, elk and deer. Any reduction in herbaceous growth and in the acorn crop, then, would have negative impacts, especially if these habitat elements are a limiting factor to a species. It is known which species utilize these habitat elements, but it is not known if these elements are limiting to these same species within the watershed.

Terrestrial Wildlife & Fire and Fuels Issue

As the Squaw Valley Creek Watershed is an area of contiguous high quality late-successional habitat, the effective management of fire risk is a high priority to maintain and promote these conditions.

Concerns within the Iron Canyon LSR include the checkerboard land ownership, extensive logging history, dry climate and its high risk to large scale disturbances that remove habitat (e.g. wildfire). Linkage with other LSRs is also a concern because of limited dispersal habitat between LSRs. Highway I-5 and private property separate RC-334 and RC-335 and private property separates RC-335 from both RC-357 and RC-336 (USDA Forest Service 1999). Therefore, as with the CHU described above, the protection of this LSR and watershed from a severe, stand replacing event is a high priority for conservation of the species associated with the late-successional habitat present in the area.

Terrestrial Wildlife & Late-Successional Reserves Issue

A network of reserves was established by the Northwest Forest Plan to provide old-growth forest habitat, provide for populations of species that are associated with late-successional forests, and to help ensure that late-successional species diversity would be conserved (USDA Forest Service 1999). This network consisted of Late Successional Reserves (LSR), 100-acre core areas, and Managed Late Successional Areas (MLSA). A set of management standards and guidelines was established for these areas and incorporated into the Shasta-Trinity National Forest's LRMP.

The management objective within LSRs is to protect and enhance conditions of late-successional forest ecosystems. Protection includes reducing the risk of large-scale disturbance, including stand-replacing fire, insect and disease epidemic, and major human caused impacts. The California Klamath Province and California Cascade Province, which includes the Squaw Valley Creek Watershed, have been identified as being included in an area of "elevated risk to large-scale disturbance due to changes in the characteristics and distribution of the mixed-conifer forests resulting from past fire suppression" (USDA Forest Service 1999). Risk reduction and efforts are encouraged where they are consistent with the overall recommendations in management guidelines.

Within the LRMP, the purpose of Prescription VII (Late-Successional Reserves) is "to provide special management for Late- Successional Reserves and Threatened and Endangered (T&E) species". It also includes special, selected sensitive wildlife species which are primarily dependent on late seral stage conditions. This prescription also emphasizes retention and enhancement of sensitive plant species, old-growth vegetation, and hardwoods. Sensitive fish and wildlife species, which are dependent on riparian areas, will be managed in accordance with the standards and guidelines in Riparian Reserves" (LRMP p. 4-43).

Within a forest-wide assessment of the network of LSRs on the Shasta-Trinity NF, catastrophic wildfire was identified as one of the greatest threats to further loss and degradation of habitat for late-successional associated species (USDA Forest Service 1999). This assessment refers to fuel reduction treatments within stands of late-successional and old-growth forest habitat as essential to maintaining and protecting them. It describes low and moderate intensity fire as one of the important ecological processes essential for the development and maintenance of late-successional and old-growth forest ecosystems.

Within the LSR Assessment, the following objectives are described to guide the development and application of treatments within LSRs:

- Space for individual and population growth, and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal;
- Habitat that is protected from disturbance and/or representative of the historic, geographical, and ecological distributions of a species

As described by the Forest Plan, the goal of wildfire suppression within LSRs is to limit the intensity of all fires. However, it also states "when watershed analysis, province-level planning, or Late-Successional Reserve assessments are completed, some natural fires may be allowed to burn under prescribed conditions".

Two levels of criteria were established within the LSR Assessment – the first level establishes priorities for the treatments of the LSRs within the network as a whole. The second set of criteria is developed to more specifically guide the placement of management activities within LSRs, and are to be used at the project level to identify treatment areas within and adjacent to those LSRs. Objectives, criteria, and potential treatments are described to identify situations triggering further analysis, planning and implementation.

LSRs were identified that are currently at a high percent of the expected late-successional sustainable level and are at a high risk to loss by large-scale disturbance. Of the 24 LSRs analyzed on the Shasta-Trinity NF, Iron Canyon LSR was one of the top four LSRs identified as having the greatest sustainable level of late-successional forest and that also have the highest risk.

Iron Canyon LSR was identified as being at 66 percent of the expected late-successional sustainable level with 25,298 acres in size class 4 (i.e. 25-40" dbh) or above. It was also identified as having a 77 percent risk of high mortality (stand replacing) fire – with 68,639 acres at risk of loss.

Terrestrial Wildlife & Access Issue

Roads can adversely affect and can benefit ecosystems in several ways. Road construction can remove and fragment habitat, increase sedimentation in streams, impede stream flow, affect wildlife distribution and movement, introduce invasive species, increase detrimental human use impacts, and increase the potential for outside disturbance factors (USDA Forest Service 1999). However, roads also provide access to areas for fire suppression and important ecosystem management actions.

In the forest-wide LSR Assessment, existing roads within LSRs are described as potentially beneficial, as they can provide access for controlling wildfire and function as fire lines in prescribe burns, as well as provide access for other habitat management actions such as thinning and pest control. However, it also states that in most cases new roads should be constructed in LSRs only when they are connected to a larger action that results in a long term benefit to late-successional habitat (USDA Forest Service 1999). Some exceptions include access to private inholdings and improvements to provide for increased public safety.

Knowledge regarding specific effects of roads is limited. The adaptability of most populations to disturbance is unknown. Although a few studies have been done on the effects of off highway vehicles on northern spotted owls, impacts to the majority of the other species are largely unknown. Exact thresholds have not been determined concerning maximum acceptable road densities within LSRs. Some studies on effects of roads on deer and elk suggest that use of habitat decreases from moderate to low with road levels between 2.0 to 3.5 miles of open road per section (USDA Forest Service 1999). In 1991 Freel included road density in his marten and fisher habitat capability models and concluded that areas adjacent to established roads may still be used if the road density and human activity is low. Other studies have indicated that open roads within fisher habitat are a major limiting factor in population levels, (i.e. lead to high levels of mortality). Based on the findings of Freel (1991), open road densities above three miles per square mile of habitat could be a practical threshold to consider (USDA Forest Service 1999). Assessments of open road density within LSRs on the forest indicate a range from 1.4 to 5.0 miles of open road per square mile (USDA Forest Service1999).

Currently, the Squaw Valley Creek Watershed has very limited access for motor vehicles, thereby creating an area of relatively undisturbed and unmanaged habitat. Because of this inaccessibility, wildlife in the watershed has enjoyed a remote existence, relatively free from human disturbance and human caused fires when compared to adjacent watersheds. However, with this level of remoteness also comes certain habitat conditions associated with a lack of management, i.e. increased fuels in the form of ladder fuels and/or downed woody debris and increased amounts of decadent brush.

Aquatic and Riparian-Dependent Species and Habitats

Aquatic and Riparian-Dependent Species of Concern

There are no federally listed threatened or endangered fish species within the analysis area. Efforts are being proposed and are underway to re-introduce native salmon populations into areas of suitable habitat above a few permanent dams within California, including Shasta Dam. The future status of these experimental fish populations is unknown at this time.

The Bureau of Reclamation in cooperation with NOAA's National Marine Fisheries Service, the California Department of Water Resources and other fisheries agencies are proposing a program to provide fish passage above Shasta Dam for Sacramento River winter-run and spring run Chinook salmon (*Oncorhynchus tsawytscha*). These efforts are part of the long-term continued operation of the Central Valley Project and are intended to re-introduce these fish to historical habitats in the McCloud River basin including Squaw Valley Creek. By March, 2012 fish passage for adults via "trap and transport" is planned for implementation while ongoing studies to develop and assess long-term upstream and downstream fish passage alternatives continue (NMFS 2009).

Other aquatic species of concern include Forest Service Region 5 sensitive species and survey and manage mollusk species. Sensitive and Survey and Manage aquatic mollusk species known to occur or that may occur within the analysis area are listed in Table 24.

Table 24. Aquatic species of concern in the Squaw Valley Creek Watershed.

Common Name	Scientific Name	Type	Known Locations
R5 Regional Forester Sensitive Species			
Nugget pebblesnail	*Fluminicola seminalis*	snail	McCloud River and its tributaries
Survey and Manage Species			
Potem pebblesnail	*Fluminicola n.* sp 14	snail	Upper Shasta and Pit River Basin

Forest Service Sensitive Species

Nugget Pebblesnail - The nugget pebblesnail prefers cool, clear, flowing water and gravel-cobble substrates. It is typically found in larger creeks and rivers, and prefers well-oxygenated streams and stable gravel-boulder substrates, but also occurs on soft, mud substrates in large springs (Frest and Johannes, 1999). Presently, this species occurs in the Pit and McCloud River basins, and is known from only two sites on the Shasta-Trinity NF (Furnish and Monthey 1998).

Survey and Manage Species

Potem Pebblesnail - The Potem pebblesnail is associated with cold-spring complexes in the Upper Shasta and Pit River systems and has been found on National Forest System lands during surveys (Furnish and Monthey 1998). It occurs in muddy to silty substrate in small cold springs and spring runs. Sites are often shaded (Frest and Johannes, 1999). This species is considered a spring snail, meaning it prefers small, perennial, coldwater spring habitats.

Aquatic and Riparian Habitats

Optimal aquatic and riparian habitats, as well as standard thresholds adequate to assess their conditions, are difficult to describe in terms of specific habitat parameters. One set of criteria cannot fit all streams. One of the most difficult aspects of this process is how to scale habitat parameters to the size of a stream and to the geologic morphology of its watershed. Pools in smaller streams tend to be shallower than pools in larger streams, due to lower velocities and reduced scour. Streams in a watershed having large areas of decomposed granitic soils generally have a higher percentage of fines in substrates than streams within watersheds composed mostly of competent bedrock. Within the Squaw Valley Creek Watershed, there is very little information available on optimal stream habitat conditions. More thorough analysis of existing data and stream surveys could help refine appropriate ranges of conditions for determining the quality of current aquatic and riparian habitats.

Cool, clear, flowing water with high levels of dissolved oxygen, a variety of pool habitats, deposited gravel in pool tailouts, intact riparian areas with vegetative and topographic shade, and large woody debris are important habitat parameters to maintain for healthy aquatic populations. Maintaining or improving these habitat conditions in perennial streams within the analysis area would contribute to providing high quality habitat, critical for maintaining populations of desired fish species. Localized cold spring complexes and spring-fed cold, clear waters with low amounts of fine sediments are critical for maintaining populations of other sensitive and Survey and Manage mollusk species.

Fish-bearing Streams

Within the Squaw Valley Creek Watershed there are approximately 30 miles of fish-bearing streams on National Forest system lands, as shown in Table 25. Larger fish-bearing streams within the analysis area include Squaw Valley Creek, Tom Dow Creek and Tom Neal Creek. Trout species dominate these streams (see Map 20).

Table 25. Fish-bearing streams and miles of suitable habitat

Stream Name	Miles of Habitat
Squaw Valley Creek	11.6
Tom Dow Creek	4.0
Dutch Creek	1.9
No Name	2.3
Tom Neal Creek	5.0
Bear Trap Creek	2.3
Cabin Creek	2.1
Total	**29.2**

Other perennial streams in the analysis area include Cold Spring and Trough Creek on public lands, and Willow, Cottonwood, Connor, Dairy and Pig Creeks on private lands. There are also several smaller spring-fed streams and intermittent stream channels that may provide habitat for aquatic species during parts of the year.

The perennial fish-bearing streams within the analysis area generally provide good fish habitat. These streams are in dynamic equilibrium with respect to adequate cold water flow, bedload and the delivery of woody material, which has resulted in the formation and maintenance of habitat features such as pools and runs that are critical to the production of trout. The smaller tributaries are also functioning well, but are limited as fish habitat due to their small size, steep gradients and reduced summer flows.

Riparian Reserves

Currently designated Riparian Reserves in the watershed total approximately 13,541 acres, including streams within the watershed and geomorphological features such as inner gorges and slides and other unstable areas. Riparian Reserves encompass both federal and non-federal (private) ownerships within the Squaw Valley Creek Watershed. See the Land Allocations and Management section for further discussion on Riparian Reserves.

Human Uses

Human use within the Squaw Valley Creek Watershed is relatively low compared to that of other watersheds on the Forest. The watershed's isolated location, limited number of publicly accessible roads and trails, as well as unique land designations restricting use all contribute to this condition.

Methodology for analysis

Current human use in the watershed was assessed via reviewing photos (historic vs. current), CRMP documents, and the Shasta-Trinity LRMP (e.g. Visual Quality Objectives, Visual Resource Management standards, Recreation Opportunity Spectrum guidelines, and direction for Slate-Delta, McCloud River, and Nosoni management areas). GIS queries were also performed using all relevant layers from the Forest GIS Library (2010). Discussions with Forest personnel and other local experts were also critical to this assessment.

Heritage Resources

Some of the 24 known heritage resource sites within the Squaw Valley Creek Watershed boundary have not been formally recorded, although human or natural impacts to most of the sites have been documented. For those sites that have been formally documented, the records have not been updated since the original site visits approximately three decades ago (1978-1990), so the full extent of impacts from human use is not currently known. Generally, the site records indicate that sites located off the beaten path had relatively few human impacts and were more subject to natural weathering and erosion. The sites adjacent to trails and road were more susceptible to modern camping and vandalism. Road construction and logging have impacted a few of the sites in the watershed.

There are both prehistoric and historic use areas along Squaw Valley Creek and its tributaries; including six prehistoric sites and two historic camps that date circa 1908-1920 (one of these was also a prehistoric camp). Most of this area has not been formally surveyed and the potential is very high for additional sites, both historic and prehistoric. Known impacts to the above sites include modern trails, road disturbances, and modern camping. These activities would continue to impact the sites if access to the area were increased.

Historic use along Tom Neal Creek began in the early 1900s and was facilitated by the creekside Tom Neal Trail. This trail appears on the 1916 Shasta National Forest Map as passable for animal pack outfits. There are three relatively remote, contemporaneous historic camp sites associated with use of this trail, two of which had evidence of natural weathering and creek erosion and all of which had shown evidence of minimal to no human impacts at the time they were recorded in 1989. The Tom Dow Trail, however, was reportedly cleared for motorcycle use by marijuana growers in 1978, although associated sites were not necessarily impacted by this activity (Hesseldenz 2011 personal communication).

About three miles south of the Tom Neal Trail, there is another historic transportation route along the Tom Dow Creek. The Tom Dow Trail was passable by pack trails as early (or earlier than) 1900 (Hesseldenz 2011 personal communication), although it appears on the 1916 Shasta National Forest Map as passable for foot travel only until it joins with a pack outfit trail at the saddle, and a jeep road further along. There is a nearby historic camp that may be associated with use of this trail. The 1989 site records for the Tom Neal Trail and Tom Dow Trail indicate that neither of the trails was altered much (or at all) along the majority of the paths, and that original blazed trees, intended to indicate the trail routes, were still visible at that time. The records also state that the trails were maintained for use into the 1970s and that both had been cleared of brush and fallen logs recently (circa 1989); probably in association with the maintenance coordination efforts made by the McCloud River Club (in conjunction with the Forest Service), which were abandoned in 1989 when energy was refocused toward the new Squaw Valley Creek Trail.

Girard Ridge was historically used as a Forest Service fire lookout location. A cabin built on the southeast slope of Girard Ridge circa 1908 was used as a seasonal fire lookout. This location was used as a marijuana garden circa 1985, and modern trash was noted at the site in 1989. Another fire lookout was built on the southeastern peak of Girard Ridge, just outside the watershed boundary, in 1931 and used continuously for this purpose until in 1981. It was then used sporadically during lightening storms in the 1980s and possibly later. This lookout is eligible for the National Register of Historic Places. It was restored to an historic appearance in 1999 and is now used as a recreational rental cabin. Vandalism to the structure has been reported over time.

Two additional historic sites (circa 1930s) are also located on Girard Ridge. These were potentially associated with either the barite mining nearby or historic hunting activities. One of these sites exhibited extensive damage from bottle hunters at the time of recording in 1989, as well as disturbances from an old logging skid trail.

In addition to the aforementioned sites on Forest Service land, there are at least four prehistoric, one historic, and two multi-component sites known to be located on private property within the watershed along Squaw Valley Creek or one of its tributaries. There are likely more sites located on private land than are known to the Forest Service.

Recreation Resources

The Squaw Valley Creek Watershed has varied recreation opportunities. Although recreational use is generally low compared to that of other watersheds in the area, there are two notable stakeholder groups actively involved with recreation issues: the partnerships created under the Coordinated Resource Management Plan (collectively referred to as “the McCloud CRMP Group”), and the Mount Shasta Trail Association. As stated previously, the CRMP focuses on coordinating management activities with principle landowners and public agencies in the McCloud River drainage area. The Mt. Shasta Trail Association partners with the Forest Service in designing, constructing, maintaining and using trails in the area.

Wild and Scenic River Status

Known for its “unique and outstandingly remarkable features” (LRMP p. 4-121) a 10.5 mile stretch of Squaw Valley Creek has been found eligible for Wild and Scenic River status. In lieu of actually recommending this designation; however, the Forest Service works with adjacent private landowners under the CRMP regarding the river corridor (see Map 11 and Map 12). A primary objective of the CRMP is to retain the characteristics of the river which made it eligible for wild and scenic river consideration (LRMP p. 2-6) Should the requirements of the CRMP not be fulfilled, the Forest Service could pursue recommendation for the lower section of Squaw Valley Creek for Wild and Scenic River status (USDA Forest Service 1994).

Special Use Permits for Recreation

Several activities on Forest Service land require special approval. The Agency's special-uses program authorizes uses on NFS land that provide a benefit to the general public and protect public and natural resources values.

Whitewater Boating

Squaw Valley Creek is a tributary of the McCloud River, originating north of the watershed near Mt. Shasta. A popular Class IV whitewater boat run in the area is a 10.5 mile stretch of Squaw Valley Creek between the Cabin Creek trailhead and the McCloud River confluence. To date, all applications for commercial use permits to conduct rafting operations on Squaw Valley Creek have been denied, as the stream has been found to be unsuitable or inappropriate for commercial rafting. Non-commercial whitewater boating has been identified by the CRMP as an appropriate recreational use of the Squaw Valley Creek; however, the plan also stresses the need for further education of the boating public regarding resource, ownership and safety issues (USDA Forest Service 1998). In the recent past there have been reported trespassing issues between boaters and private landholders. The only present day boating use is via single-kayak boaters. There are few camping spots along this stretch of the creek and boaters typically use it for day paddle only. Once Squaw Valley Creek reaches the confluence of the McCloud River, boaters must pass through private property to the take out at McCloud Bridge at Shasta Lake.

Fishing

Squaw Valley Creek is a popular spot for anglers' pursuing large wild trout. Protective angling regulations limit take to only 2 fish per day. This stream has been surveyed and recommended for inclusion into the State's Wild Trout Stream Program, but to date has not been designated as such. The only commercial fishing use is by a handful of guides who fish downstream from the Cabin Creek trailhead (Smith 2011 personal communication). Dispersed recreational uses, including hunting and fishing, are considered generally consistent with the objectives of Late-Successional Reserves (USDA Forest Service and USDI Bureau of Land Management 2001).

Recreation Residences

A cabin built on the southeastern peak of Girard Ridge in 1931 was used as a fire lookout (see Heritage Resources section) until in 1981, then only sporadically during lightening storms in the 1980s and possibly later. It was restored to an historic appearance in 1999 and is now used as a recreational rental cabin. The lookout is eligible for the National Register of Historic Places. There are no other recreation residences on public lands within the watershed analysis area.

Trails and Campgrounds

There are no developed campgrounds within the watershed boundary. The Ah-Di-Nah campground 1.5 miles east of the watershed receives moderate use (USDA Forest Service 1998). There are several primitive campsites along the Squaw Valley Creek Trail. Also, there are three, contemporaneous historic camp sites associated with use of the Tom Neal Trail (See Heritage Resources). A potential campground site was identified along lower Cabin Creek during the Gin Timber Sale in the late 1980's, and the sale was modified to protect potential future campground amenities (shade trees and visual quality). This campground site was identified as a potential means to accommodate overnight use in the vicinity of the Cabin Creek Trailhead for the PCT and Squaw Valley Creek Trail without locating such a facility right at the trailhead where there is not sufficient room (Hesseldenz 2011 personal communication).

Officially recognized as recreation facilities, but commonly thought of as part of the transportation system, there are approximately 21 miles of National Forest System Trails (NFST) within the watershed analysis boundary. These trails include: the Pacific Crest Trail (PCT), the Squaw Valley Trail, the Tom Neal Trail and the Tom Dow Trail. Approximately 11 miles of the PCT bisects the watershed from east to west. The PCT may be accessed within the watershed via the Cabin Creek Trailhead, where the PCT also connects to the Squaw Valley Creek Trail. The Squaw Valley Creek Trail offers an easy to moderate 8 mile round trip hike by connecting to the Squaw Valley Creek Road. Both the Tom Neal and Tom Dow trails are in the southern portion of the watershed and are approximately 2.5 miles long each. These trails are open year-round as snow permits (generally April through November). The majority of the users are backpackers, equestrian groups (very little use), hunters, and anglers (LRMP p. 3-8). See the Heritage Resources section and Map 21 for further information regarding these trails. There is a historic unmaintained trail called the Castle Crags Trail that connects Castle Crags State Park and the Tom Neal trail however it is not a Forest system trail and does not receive routine maintenance (Hesseldenz 2010 personal communication). The PCT now roughly follows the route of the old Castle Crags Trail, but includes several large switchbacks in order to reduce steepness of grade.

The CRMP outlines consensual agreements between public agencies and private landowners for development of access to trail systems, dispersed recreation and public facilities. Supplemental Management Direction of Management Area 10 highlights the need to develop trail access to and along Squaw Valley Creek, as well as to emphasize the dispersed recreational use of Tom Dow, Tom Neal, and the Pacific Crest Trail systems (LRMP p. 4-123). To this end, there are currently proposals to: (1) extend the Squaw Valley Creek Trail downstream to connect with the Tom Neal Trail; (2) improve the Tom Neal Trail; (3) connect the top of the Tom Neal Trail with the PCT; and (4) extend the Squaw Valley Creek Trail further downstream to connect with the Tom Dow Trail and reroute the lower end of the Tom Dow Trail off of private property (the McCloud River Club).

Recreation Opportunity Spectrum (ROS)

The recreation opportunity spectrum (ROS) is a system that inventories National Forest lands for a variety of existing and potential recreation opportunities based on the size, distance from roads, and degree of development of a given area (LRMP p. 3-15). Supply (i.e. the quantity of recreation facilities or settings available for visitor use) is assessed along with demand for various types of recreation. The three recreation settings, or classes, pertinent to the Squaw Valley Creek Watershed are: Semi-primitive non-motorized (SPNM), Semi-primitive motorized (SPM), and Roaded Natural (RN) (Table 26 and Map 21). Semi-primitive settings include wild and scenic rivers, large lakes, and backcountry areas. Some of these areas are managed for motorized travel (e.g. boat or off-highway vehicle). Other areas are managed for non-motorized travel (e.g. foot, horseback, mountain bike, raft, and kayak). For complete definitions of ROS classes refer to the Project File.

Table 26. Acres and Percent of ROS Classes in the Squaw Valley Creek Watershed Analysis area.

ROS Code	ROS Name	Acres	Percent of Designated Area	Percent of Watershed Analysis Area
RN	Roaded Natural	272	2%	1%
SPM	Semi-Primitive Motorized	23,692	96%	63%
SPNM	Semi-Primitive Non-Motorized	586	2%	2%
Total		24, 650	100%	66%

Unroaded Non-Motorized Recreation

As discussed in Chapter 1 (Land Allocations and Management Direction discussion) the Shasta-Trinity LRMP describes various management prescriptions developed through Forest planning process. Of the various prescriptions directly relating to recreation, only the Unroaded Non-Motorized Recreation (Prescription 1) occurs within the watershed analysis boundary. Prescription 1is described as follows:

"The purpose of this prescription is to provide for semi-primitive non-motorized recreation opportunities in unroaded areas outside existing Wilderness while maintaining predominantly natural-appearing areas with only subtle modifications. Also emphasized in this prescription is retention of old-growth vegetation and management of wildlife species requiring late seral stage conditions" (LRMP p. 4-45).

Approximately 188 acres, or 0.5 percent of the watershed, is allocated for unroaded non-motorized recreation. This area occurs in the southern portion of the watershed near Garrett Flat (see Map 21).

Transportation System and OHV Routes

The Squaw Valley Creek Watershed contains 147 miles of road; 32 miles of which occur on Forest Service lands (see Map 22). Road densities in the watershed are low; 5.1 and 0.9 miles of road per square mile for private and federal lands respectively (Table 27). Data on operational maintenance were taken from the Shasta-Trinity NF GIS library.

Table 27. Roads in Squaw Valley Creek Watershed Analysis area by jurisdiction and operational maintenance.

Jurisdiction	1 – Basic Custodial Care (Closed)	2 – High Clearance Vehicles	3 – Suitable for Passenger Cars	4 – Moderate Degree of User Comfort	None	Total
FS – Forest Service	7.78	31.48	0.00	2.37	0.00	41.64
C – County, Parish, Borough	0.00	0.00	0.00	0.00	2.07	2.07
P - Private	0.10	0.10	0.00	0.00	103.47	103.67
Total	7.88	31.58	0.00	2.37	105.54	147.38

Forest Service roads in the watershed were primarily constructed for management activities. These roads have a variety of maintenance levels and are often impassible by passenger car.

Private roads within the watershed are also of varying quality. Construction of new road is not currently occurring however maintenance does occur. The heaviest use of roads occurs in the spring, summer, and fall when public use is at its highest.

Squaw Valley Creek Road and Hawkins Creek Road are the two main access routes which enter the watershed from the north through private property. Squaw Valley Road is County owned (CR 1) and paved to the junction with Dairy Creek where it then becomes a National Forest Service (NFS) system road. The unpaved continuation of Squaw Valley Road accesses the Cabin Creek Trailhead and is not gated. Some of the bridges in the watershed analysis area are not in sufficient condition to support all vehicle types, creating safety and access concerns. These access limitations pose concerns regarding recreation opportunity availability as well as fire suppression efforts. Private ownership of this portion of road limits also public recreation opportunities to non-motorized use only.

The western portion of the watershed contains the 38N93 and 39N13 NFS roads (which have access points at Girard Ridge). These roads also offer access to the Pacific Crest Trail (PCT), the Tom Neal Trail, and the Tom Dow Trail. Roads in the lower east half section of Squaw Creek Watershed are jeep trails and non-maintained roads.

There are several high-clearance vehicle roads or trails within the watershed (see Map 22). One popular jeep trail runs from Skunk Hill near McCloud Reservoir the top of Bald Mountain. This trail runs along the ridge of the adjacent Lower McCloud watershed for 8.5 miles and accessible mostly by OHV or four wheel drive vehicles, but the road is now gated at Skunk Hill. Another popular jeep trail runs for approximately six miles along Girard Ridge from the back end of Tom Neal drainage to Tombstone Mountain, passing the Tom Dow trailhead along the way.

Caves

Several limestone caves are known to exist in the watershed; however, they are still relatively unknown by the public and use is fairly low. Although human use of the caves is minimal, damage or vandalism to this resource is of concern. Caves in the watershed are culturally, historically, and biologically significant. See the Physical Sciences section for a more detailed discussion of cave resources.

Mining Resources

There are no active mining claims within the watershed. Historically, mining activity was limited to approximately five locations, including one on Girard Ridge in the western portion of the Tom Neal Drainage, where barite extraction was practiced. There is no infrastructural mining development on Forest Service land within the watershed boundary. See the Heritage Resources of Water Quality sections for further discussion.

Visual Resources and Scenery

The LRMP, the National Forest Management Act (NFMA), and the Travel Management Rule all contain management direction for visual resources and scenery. The LRMP sets visual quality objectives (VQOs) which establish minimum acceptable thresholds for landscape alterations from an otherwise natural-appearing forest landscape. Roads and trails create linear alterations in landscapes that can be mitigated through sound design. Roads may present uncharacteristic line qualities in forest landscapes if left unmitigated. Landscapes with a dense canopy cover and/or sloping terrain have the capability of masking these linear alterations; sparsely covered landscapes have less capability.

Scenic values are relatively high in the watershed. Trails and roads within the watershed are not easily viewed from a distance due to copious vegetation cover as well as steep hillsides. The natural integrity of the area, thus, is mostly uninterrupted by roads and visual impairments, allowing for a more ‘primitive’ and scenic wilderness setting. The old-growth vegetation, the stream corridors, and the associated plant and wildlife species all contribute to this watershed’s high visual quality.

Patch clearcuts on public and private lands within and outside the analysis area have altered background visual resources, as viewed from within the analysis area. The most noticeable clearcuts that may be visible from within the analysis area are located in the Cabin Creek drainage, on the north side of a prominent ridge north of the Trough Creek drainage, in the back end of the Tom Neal Creek drainage (mostly in the north fork), and in Ladybug Creek, Claiborne Creek, and Chatterdown Creek drainages on the southeast side of the McCloud River as viewed from Bald Mountain and Tombstone Mountain (Hesseldenz 2011 personal communication).

Fire Effects on Human Uses

As mentioned in the Fire and Fuels discussion, fire effects to several resources may impact the recreation experience and other human uses in the analysis area. Such impacts include, but are not limited to, a degradation of visual quality near large areas of burned landscape (as evidenced by fire damage upslope from the Cabin Creek Trailhead), restrictions on motorized and non-motorized recreation (e.g. trail or road closures), poor air quality during wildfire events, as well as degradation of water quality and related effects to fishing, rafting, etc.

Chapter 4: Reference Conditions

The purpose of this chapter is to explain how ecological conditions have changed over time as a result of human influence and natural disturbances. A reference is developed for later comparison with the current conditions over the period that the system evolved and with key management objectives.

This chapter begins with a historic overview that summarizes the natural processes and land-use activities in the watershed. The remainder of the chapter follows the six core topics that have been presented previously.

Discussions of physical features, biological features and human uses can generally be segregated into three distinct time periods, as follows:

- Pre-1900: During this period, significant Anglo-American influences were absent. Although native peoples used and managed the area, the ecosystem was functioning under essentially natural conditions during this time.
- 1900-1945: During this period, human influences began to affect natural processes in the watershed. The area began to experience increased effects from settlement, mining, wildfire suppression, timber harvest, and road construction activities. Water from the Upper McCloud River began to be diverted to the lumber mill in the town of McCloud, with the overflow water adding to the base flow of Squaw Valley Creek.
- 1945-present: This period began with the completion of Shasta Dam and the subsequent creation of Shasta Lake in 1945, thereby blocking prolific historic anadromous fish runs up the McCloud River and Squaw Valley Creek. Major human influence on watershed ecosystem processes has been documented during this time period.

Physical Features

Geology, Geomorphology, and Erosion Processes

Geology

Historical air photos were briefly examined in order to gain an insight into reference conditions relative to erosional processes, with a focus on landsliding. A sample of photo years was selected to straddle some of the largest floods which are known to have occurred in the recent past (1964 and 1997). Air photos from 1970, 1983, and 1998, and Google Earth Images from 2004 were utilized to accomplish this. Air photos exist from as far back as 1944, but these were not examined. Methods included examining air photos stereoscopically and identifying active landslides and channels which appeared in the photos to have been recently altered by scour or deposition (usually indicated by lighter color and lack of riparian vegetation). Notes were taken during photo examination however no mapping was performed during the process.

Summary of Air Photo Investigation

The air photo investigation revealed that the floods of 1964, and 1997 resulted in very limited and localized channel alteration in the main stem of Squaw Valley Creek and some of the main tributaries. There were very few landslides, and no obvious debris flows with landslide sources. However, some scattered small steep headwater channels were altered by scour/deposition. Channel alterations on the main stem and some tributaries occurred in all three photo years, but it was most evident on the 1998 air photos. The effects of the 1964 flood may actually have been greater than those from the 1997 flood, since the post-flood photos examined were taken 6 years after the flood, allowing time for revegetation. The lack of landslides and debris flows in Squaw Valley Creek is likely the result of a variety of factors, including the scarcity of dormant landslides in the watershed, intact vegetation (absence of recent fire), and few roads. A brief description of observations from each photo year follows.

1970

The main stem of Squaw Valley Creek down to the mouth exhibited evidence of recent bed mobilization (scour or deposition), as did the lower reaches of Mule Shoe Creek. No evidence of scour was seen in the headwaters of Dutch Creek. Near Tombstone Mountain, there was possible scour in a tributary to Tom Dow Creek, in Scorpion Gulch, and on a NE facing slope near Hill 4896 (USGS7 ½ minute topographic map). Similar scour was noted in a steep NW flowing draw in this vicinity near a heliport on the ridge. In the un-named south fork of Tom Neal Creek, there was some scour or talus in a steep headwall basin in /Section 31. In the headwaters of Tom Neal Creek, there are two small draws on opposite sides of a long narrow ridge, and there was minor scour in the southern tributary in Section 19. There were a few small, low order channels with possible recent channel alterations dispersed across the watershed in steep headwater areas. However, these may actually have been talus accumulations in the channels which is difficult to distinguish from channel alterations on air photos.

1983

Extensive new tractor logging and what looks like new terracing was evident on private lands north of Forest Service administered lands. This occurred between 1970 and 1983, since only limited logging was evident in this area on 1970 photos. There was some bed mobilization in the main stem of Squaw Valley Creek. The winter of 1982-1983 resulted in numerous landslides in other parts of the Klamath Mountains.

1998

There was strong evidence of bed mobilization on Squaw Valley Creek near the mouth (lower half mile). Similar alteration was visible near its junction with Tom Neal Creek, and below its junction with Cabin Creek (the altered segment was very narrow in this area). There was prominent channel alteration in the area of horseshoe meanders on Squaw Valley Creek in and adjacent to Sections 22-26, giving the channel a white-looking appearance in this area. There was minor alteration to a tributary in Section 27 flowing into Squaw Valley Creek from the east. The south facing bank of this channel is a brush field. At the junction, Squaw Valley Creek itself was not altered. There was minor alteration in a steep channel in a headwall basin in Section 18 on a north-facing slope near Tombstone Mountain.

Hydrology

Pre-1900

Natural processes that controlled peak and base flows in the Squaw Valley Creek Watershed prior to European settlement did not noticeably change between this time period and present-day. Peak and base flows within the watershed were controlled by the prevailing climate; specifically regarding variations in annual precipitation. Variations in the abundance and distribution of vegetation within the watershed also affected peak and base flows. While flooding provided the mechanism to trigger large inputs of sediment to streams, fire was the primary upslope disturbance. Fires, either through lightening or human ignition, frequently burned through the area, affecting watershed conditions (USDA Forest Service 1998).Wetter periods brought increased rainfall which then reduced wildfire activity and stimulated vegetative growth. Increases in evapotranspiration likely partially offset increases in base flows during these wetter periods. Conversely, dryer periods resulted in lower flows that were offset by decreased evapotranspiration following catastrophic fires. Settlement of the area began in earnest in the mid-1800s, primarily in Squaw Valley, however the extent of water use is unknown.

1900-1945

Between 1900 and 1945 peak and base flows within the Squaw Valley Creek Watershed were not affected significantly by land-use activities. Changes to timing and total peak flows may have measurably increased; especially downstream areas in closer proximity to settlement and other land use activities. The scope of recreation and mining activities was limited and fire suppression activities were only partially effective at controlling wildfires. Logging, milling, and road construction increased throughout this period, and consequently the affects to water flow and sedimentation likely increased. Controlled burns, undertaken by grazing permittees to enhance range forage, may have affected water flows. Peak and base flows in the Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek Drainages may have increased for short periods of time following such fires. Settlement in Squaw Valley rose steadily during this period. Flows were therefore likely affected by logging and milling operations, as well as domestic and agricultural use.

1945-present

The Squaw Valley Creek Watershed Analysis area generally remains closer to reference conditions than most watersheds in California. The three lower drainages within the analysis area, in particular, do not vary significantly from what are believed to be reference conditions. The fact that all water courses in the watershed are free-flowing is noteworthy. The area remains generally undeveloped however land use within the watershed has altered hydrologic conditions and processes. Activities such as mining, logging, road construction, agriculture, fire and fuels management, and human settlement have all altered the landscape to some extent.

Stream Channel Morphologies

Pre-1900

Stream channels within the analysis area formed as a result of the uplift of the Klamath Mountains and the formation and continued eruptions of Mount Shasta. Climate, substrate, and stream gradient are generally major factors influencing channel formation. Prior to European settlement, channel morphologies were controlled by peak flows and hillslope erosion processes. Lateral movement of the channels in transport reaches was largely influenced by geomorphological characteristics of the area. Frequent fires, periodic droughts, and mass wasting activities also affected channel development and influenced channel stability. Several channel types (e.g. swales, colluvial, bedrock, and cascade) located in upland areas that had been frequently burned likely exhibited unstable characteristics due to the high sediment inputs and lack of large woody debris characteristic of burned areas. These upland channel types likely hosted aquatic and terrestrial plant and wildlife species adapted to frequently burned, early seral habitats rather than those adapted to the forested riparian areas found throughout the watershed today.

Channel morphologies were probably similar to those found in the watershed today. Because impacts from pre-suppression burning appear to have affected midslopes and ridgetops more than inner gorge areas, it is believed that the larger channel types such as step-pool and pool-riffle channels probably were not impacted appreciably by wildfires or mass wasting activity. Gravel and fine sediment probably accumulated in step-pool and pool-riffle channels following large wildfires and floods, however the sediment deposited during these events was probably flushed from the channel network during smaller bankfull flows occurring over the following years. Large woody debris probably played a significant role in controlling the morphologies of smaller step-pool channels; however, most large wood was probably flushed through the larger step-pool and pool-riffle channels.

1900-1945

Little information is available concerning the effects of land-use activities on channel morphologies in the Squaw Valley Creek Watershed between 1900 and 1945. Except for flat valley areas such as Squaw Valley, stream channel disturbance was very limited due to the limited level of human use that occurred in watershed during this period. Grazing likely impacted these alluvial response channels; however, the degree to which grazing activities affected stream channels and riparian areas is unknown. Some stream channels may have been impacted by land use activities such as road construction, logging, and milling; however, these impacts were probably insignificant due to the small area in which they occurred. The McCloud River Club's road was constructed from 1900-1910, but all stream crossings involved clear-span log bridges that did not affect channel morphology.

1945-present

The increasing trend of land use activities generally correlates to an increase in affects to channel morphologies. Response reaches in valley bottoms experienced the most notable changes. Downcutting and streambank stability issues have been reported to exist on several of these stream reaches, most notably upstream from the confluence of Cabin Creek. Instream and meadow restoration projects, as well as changes in management practices, have also been implemented. Interviews of various land owners reflect impressions that stream conditions on private lands within the analysis area may be improving (Henery 2008).

Vegetation succession from early to mid or late seral stands has reduced sediment input to upland and cascade channels. This vegetation shift has also resulted in reduced soil erosion as well as increased potential for coarse woody debris recruitment to upland channel types located near the ridgetops and cascade channel types located on the midslopes. Increased levels of woody debris recruitment will eventually lead to changes in the morphology and stability of colluvial, bedrock and cascade channel types.

A detailed history of timber harvesting on private land within the watershed was not available for this analysis. Impacts to channel morphologies from timber harvest were greatest in upland channels located within close proximity to ridgetops. Step-pool and cascade channel types may also have been impacted in areas where roads were constructed within stream inner gorges. The impacts associated with timber harvest activities were relatively small and were mainly limited to increased sedimentation in upland channels.

Roads impacted the morphology of upland channels throughout the watershed. Impacts were generally concentrated at stream crossings and in areas where roads were constructed within or adjacent to stream inner gorges on unstable hillslopes. Impacts to step-pool and pool-riffle channels were mostly in the form of increased sediment inputs which led to increased deposition in pools and a loss of fish habitat. Unlike the impacts from timber harvest activities which were of short duration, impacts from roads were chronic, especially from unmaintained road systems.

Common impacts to upland stream channels from roads include: channel aggradation above plugged or partially plugged culverts, channel degradation below stream crossings, and gullying along poorly drained road systems.

Water Quality

Pre-1900

Reference conditions for water quality in the Squaw Valley Creek Watershed are believed to be similar to current conditions, with the greatest changes taking place over the last 60 years (see 1945-present). The quality of water in the streams tributary to Squaw Valley Creek has always been very high. Natural processes that affected water quality in the tributary streams prior to European settlement include: climate, fire, peak flows, mass wasting activities, mudflows during Ice Age break-up (there are no longer any glaciers in upper Squaw Creek and Panther Creek drainages) and volcanic eruptions, and ash fall and pyroclastic flows during eruptions from Mount Shasta. Impacts to water quality only occurred for short periods of time during winter high flows when concentrations of suspended sediments increased. Water quality in all of the tributary streams was probably excellent between high flows and during the summer and fall when base flow conditions prevailed.

1900-1945

Little to no information is available concerning the effects of land use activities on water quality in Squaw Valley Creek tributaries during the early 1900s. Historical accounts of the watershed indicate that the water quality in the tributaries was very good during this period (Wales 1939). Water quality was likely impacted by milling, domestic uses (sewage disposal), dairy farming, and grazing activities; however, the extent of these impacts is unknown. No other land-use activities have significantly influenced water quality in the Squaw Valley Creek Watershed.

1945-present

Water quality remains high within the Squaw Valley Creek Watershed. Affects on water quality from land use undoubtedly occurs within the watershed, although the source of impacts are mostly upstream from the analysis area and within the upper portion of the analysis area (on private lands) and in drainages where most human related activities occur. Several questions remain about the extent of land use activity impacts to water quality in Squaw Valley Creek.

Increases in bacteria and nutrient levels, resultant from grazing and human sewage systems, have been identified as concerns in the watershed. Actual documentation of the sources and the extent to which they impact water quality, however, is lacking. Water use may also reduce flows and increase water temperature.

High instream sedimentation is apparent where timber harvest and road building activities occurred. Impacts to water quality from timber harvest and road construction were mostly non-apparent while these activities were occurring with the exception of those within close proximity to perennial streams. Often it was not until the following winter, during winter runoff events, when impacts would manifest themselves. Timber harvest impacts such as increases in hillslope erosion and stream turbidity appeared to be relatively short lived and occurred mainly during winter runoff events. Impacts to water quality from the road system were more persistent and ultimately appear to be more significant than those of timber harvesting.

Biological Features

Vegetation

Pre-1900

Perhaps the largest scale influence to vegetation within the watershed prior to 1900 was recurrent wildfire. Typical fire severity and return intervals are discussed within the Fire and Fuels section for this watershed analysis. Native American burning is also believed to have occurred as a standard practice within the watershed prior to the 1900s. The extent of Native American burning is not clearly known but is included when analyzing historical fire return intervals and fire severity (Taylor and Skinner 2003). Anthropological accounts indicate local Klamath tribes used fire extensively to promote acorn, berry, root, and fiber production and to hunt game (Lewis 1973).

While precise historic vegetation distribution is not known, much can be surmised from fire history and later developing vegetation conditions. Vegetation mapping from the late 1930s and early 1940s indicated much of the watershed was early seral or open canopied stands. Based upon those conditions and a historical fire regime of frequent low to moderate intensity fire, much of the vegetation prior to the 1900s was likely fairly open canopied with brush, forbs and grasses underneath. More dense stands of mixed conifers would have likely been present at higher elevations, along riparian corridors and on north facing slopes. Landscape vegetation patterns changed with the onset of fire suppression. Prior to fire suppression, fire of higher spatial complexity created openings of variable size within a matrix of forest that was generally more open than the forests of today (Skinner et al 2006).

1900-1945

Vegetation descriptions and mapping in the early years was focused on resource availability for human uses. Table 28 displays GIS vegetation data from 1934. This data was created from paper USGS maps drawn by A.F. Hassan from the California Forest Experiment Station, Gianni Foundation, College of Agriculture, University of California (RSL 2010).

Table 28. Vegetation descriptions and distribution circa 1934, Squaw Valley Creek Watershed.

Classification	Acres	Percent Total Area
Deforested lands (potential forest lands)	8,055	22%
Douglas-fir forested lands	1,635	4%
Pine and pine-fir forested lands	27,895	74%
Total	37,585	100%

The ‘deforested lands’ classification is being interpreted as lands that can be considered productive forest land, but are currently in early seral or brush conditions. Early seral habitats are valuable ecosystem components that promote biological diversity. Fire exclusion (in the form of fire suppression) has resulted in altered vegetative conditions, as brush now accounts for only 4 percent of the Squaw Valley Creek Watershed during this period.

1945-present

With increasingly effective fire suppression, vegetation communities grew denser over the next several decades. Overhead canopies began to close in both hardwood and conifer types. Understory brush persisted in the absence of fire, eventually dying out over time as it was shaded out. Even oak trees gradually became shaded out and died as they were over-topped by conifers. At mid and upper elevations, understory brush was slowly replaced by more shade tolerant fir, incense cedar and Douglas-fir regeneration. After roughly 30 years or more without fire disturbance, mixed chaparral (MCH) stands become senescent, with increasing amounts of dead leaf litter and standing dead material (Mayer and Laudenslayer 1988). In the absence of fire, vegetation growth is limited most by precipitation and soil productivity as well as locally available site resources in the overstory, and also by progressive loss of light in the understory as canopies became more closed. While soils are variable within the watershed, they are generally moderately to highly productive, with localized exceptions. Current vegetation densities reflect that overall the watershed is quite productive and able to develop forest vegetation (biomass) at levels higher than would be seen under an historic regime of more frequent fire.

As vegetation communities developed without fire disturbance, the overall distribution of cover types shifted to become increasingly tree dominated. Table 29 compares the relative distribution of vegetation types from 1945 to present day.

Table 29. Shift in vegetation type distribution – 1945 to present.

Vegetation Type	1945 - Percent of watershed	Today – Percent of Watershed
Chaparral	26%	3%
Hardwood	5%*	5%
Conifer and Hardwood/conifer mix	69%	90%
Undefined / non-forest	0%	2%

* likely includes some stands that would be typed as mixed hardwood/conifer using current standards

A similar shift in vegetation has been observed in the adjacent Lower McCloud Watershed, which shares the same local history of fire suppression. Comparisons of 1944 to 1995 aerial photography showed an increase of late seral habitat from 2 percent to 35 percent within the watershed (USDA Forest Service 1998). This comparison also showed that most of the current late seral habitat (WHR size= 5M and WHR density = 5D) arose from what were mid-seral open canopied stands in 1945. Differences in current late seral habitat were observed to be based on the type of stands they arose from. Stands that were dense canopied mid-seral in 1945 developed into single layered late seral stands with little vertical structural diversity. In comparison, late seral stands that arose from previously open canopied conditions developed as multi-layered stands of scattered large overstory trees with smaller trees growing in the midstory and remnants of brush occurring in the understory (USDA Forest Service 1998).

Timber Harvest

Historic timber harvesting activities were minimal, but are likely non-existent due to the remote location and difficultly in accessing the Squaw Valley Creek Watershed. The only records available show 320 acres of clear cutting in the ‘Gin’ timber sale, in the 1980’s and 90’s, and these areas are evident on the landscape as they are currently early seral forest or predominately brush. These acres have been artificially re-forested and are now plantations planted with ponderosa pines with an intermixed brush component and natural regeneration of conifer species.

Fire and Fuels

Pre-1900

C. Hart Merriam, Chief of the Division of Biological Survey in 1898, wrote "of the hundreds of persons who visit the Pacific slope in California every summer to see the mountains, few see more than the immediate foreground and a haze of smoke which even the strongest glass is unable to penetrate". Few forested regions have experienced fires as frequently and with such high variability in fire severity as those in the Klamath Mountains (Taylor and Skinner 1998). With frequent fire, fuel accumulations over most of the area were maintained at low levels. This frequent regime produced low-to-moderate fire severity. Within the analysis area, fire scar studies show that fire was a frequent process (Skinner 2006).

A study of fire scar analysis to understand fire history was done in the Squaw Creek drainage near the analysis area (Skinner 2006). The study showed a fire return interval (FRI) of 3 to 38 years, with a mean FRI of 12.75 years. Additional research shows that lower elevation mixed conifer forests of the Klamath Mountains historically burned every 5 to 19 years, with riparian areas burning with somewhat less frequencies (Fry and Stephens 2006, Taylor and Skinner 1998, 2003).

Studies of historical fire regimes also show that vegetation and topography strongly influence the fire regime. Frequent fires and fire-scarred trees that have survived previous fires suggest that the fire regime was characterized by low-to-moderate severities (Taylor and Skinner 1998, Skinner et al. 2006). Studies also show that upper slope positions, ridge tops, and south and west facing aspects burned at higher severities than lower slope positions and north and east aspects (Taylor and Skinner 1998, Alexander et al. 2006).

Prior to the establishment of the Shasta-Trinity NF (originally the "Shasta National Forest"), suppression concerns were primarily focused on keeping wildfires from spreading to homes and improvements. These efforts typically did not result in successful wildfire suppression. In some cases, human-caused fires or wildfires were allowed to burn for many reasons.

1900-1945

Fire suppression efforts were instituted after the establishment of the National Forest system. Since the onset of fire suppression in the early 1900s, and with the increased effectiveness of mechanized suppression techniques (fire engines, dozers, aircraft, etc.) in recent years, most fires within the watershed have been kept small. This has been primarily achieved through the use of aerially delivered firefighters and the use of retardant during initial attack. The only large fire recorded during this time period was in 1924. This was a lightning caused fire that burned approximately 3,643 acres.

1945-present

With successful fire suppression, fuels and vegetation density have increased and fires have the potential to become more intense and difficult to control. Suppression concerns have primarily been focused around homes and improvements (i.e. wildland urban interface). Concerns over fire effects to resources (e.g. wildlife habitat, soils, human uses, hydrology, air quality, etc.) have increased through time. Access to portions of the analysis area has historically been, and currently is, a suppression concern.

Shasta-Trinity NF GIS layers show fire starts and large fire history within and near the analysis area. Map 15 displays large fire history (>100 acres) and fire starts from 1987 to 2008 and pre-1987.

Species and Habitat

Threatened, Endangered and Sensitive (TES) Plants and Other Species of Concern

There is little information pertaining to the historical occurrence and distribution of sensitive plants within the watershed. Although the CNDDB and NRIS databases have entries of plant occurrences within the watershed dating as early as 1976 (e.g. Shasta eupatory), this does not indicate whether these species existed in the watershed prior to those records. These data simply tell us the first known and documented locations of the selected rare plants.

Habitat for species with limestone affinities, such as Shasta eupatory, exists in limited quantities (~ 3000 acres) in the southern portion of the watershed. It should be noted, however, that affinity does not equal endemism therefore it is possible Shasta eupatory could be found on other substrates within the watershed. Several caves in the watershed may contain suitable habitat for rare lichen, fungi, or bryophyte species. Habitat for several other species may have been somewhat altered or reduced by events or activities within the watershed such as grazing, high-severity fire, fuels accumulation from fire suppression, timber harvest, road construction, and recreational use such as hiking or OHV use.

As noted in the Vegetation discussion, much of the vegetation prior to the 1900s was likely fairly open canopied with brush, forbs and grasses underneath. This habitat type may have been suitable for plant species such as veiny arnica, northern clarkia, or Butte County frittilary. Comparisons between aerial photographs from 1944 to 1995 showed an increase of late seral habitat from 2 percent to 35 percent within the adjacent Lower McCloud watershed (USDA Forest Service 1998) implying an increase in suitable habitat for species such as mountain lady's slipper, Pacific fuzzwort, English Peak greenbriar and others.

Noxious and Undesirable Weed Species

Most of California's invasive plants originated from the Mediterranean Basin and began establishing as early as the 1730s – initially along the coasts and then spreading inland (Zouhar et al. 2008). Activities such as clear cut logging, prescribed or wild fire, grazing, and road building and maintenance have all been shown to increase the abundance of noxious weeds in the Northwest California Bioregion. Noxious weeds have competitive advantages (e.g. rapid growth rates and prolific seed crops, seeds that spread easily by wind, water and wildlife, etc.) that often allow them to colonize a site more quickly and effectively than native plants. Logging, wildfires, and grazing often expose bare mineral soils which may then be colonized by invasive plants due to a reduction in competition for space and resources.

As discussed in the Fire and Fuels section, the watershed has experienced a reduction in the frequency and extent of fire during the era of widespread fire suppression (1900-1945 and 1945-present). Although the buildup of fuels from active fire suppression created some shaded environments where light-loving invasive plants have a difficult time establishing (Keeley 2006), this accumulated fuel load also increased potential wildfire severity.

Although there have been many fire starts in the watershed, only three small (< 160 acres)wildfires and one large (< 3000 acres) wildfire have occurred in the watershed since the onset of fire suppression activities (see Fire and Fuels section). These fires resulted in the creation of new habitat for several invasive plants that may capitalize on open, bare substrates.

Historically, non-native weeds may have been introduced as early as the 1800's by fur trappers entering the watershed from other bioregions. The introduction or spread of weeds may have also increased due to livestock grazing which began in the area prior to 1877 (Guilford-Kardell 1994b). The building of roads and larger trails by Anglo-American private landowners in the watershed may also have increased weed establishment during the same time period. Occasional off-road vehicle use, via authorized and unauthorized routes, has existed in the watershed for over 50 years and has also likely increased the introduction and spread of noxious weeds along these routes.

There is little specific information pertaining to the historical occurrence and distribution of noxious weeds in the watershed. Some information may be gleaned, however, by reviewing these species' distributions at a broader scale. The following is a general description of noxious weed introduction and occurrence in California:

tree of heaven (*Ailanthus altissima*) is native to China was introduced into the eastern U.S. in the late 18th century and was quickly adopted throughout the U.S. as a desirable urban tree (Landenberger et al. 2007).

nodding plumeless thistle (*Carduus nutans*) is native to western and central Europe. The earliest records of nodding plumeless thistle in North America are from central Pennsylvania in 1852, followed by several records of its occurrence along the east coast in the late 1800s (Zouhar 2002). By 1976, nodding plumeless thistle was reported to occur in at least one out of every ten counties in the U.S (Dunn 1976).

Italian plumeless thistle (*Carduus pycnocephalus*) is native to the Mediterranean and was introduced to California in the 1930s (Bossard et al. 2000).

spotted knapweed (*Centaurea maculosa*) is native to eastern Europe. In 1920, the distribution of spotted knapweed in North America was limited to the San Juan Islands, Washington. By 1980 it had spread to 48 counties in the Pacific Northwest (Zouhar 2002).

yellow star thistle (*Centaurea solstitialis*) is native to southern Europe and western Eurasia. This species was introduced to California in 1850, possibly as a contaminant in seed grain, and spread rapidly (DiTomaso and Healy, 2007). Beginning in the late 1950s, it expanded its range within the state at an exponential rate, increasing from 1.2 to 12 million acres (Cal-IPC 2010).

Canada thistle (*Cirsium arvense*) is native to southeastern Europe and was introduced to North America in the seventeenth century as a contaminant in crop seed (Bossard et al. 2000). There is no information regarding the vector for introduction of Canada thistle in the watershed.

bull thistle (*Cirsium vulgare*) is native to Europe, western Asia and North Africa. Bull thistle likely came to the U.S. as a contaminant on ships in seed supplies or ballast. By 1925 it had been reported in several areas of California including the Klamath region (Bossard et al. 2000).

houndstongue (*Cynoglossum officinale*) is native to western Asia and eastern Europe and is believed to have been introduced to North America as a contaminant with cereal seeds (Upadhyaya and Cranston, 1991).

dyer's woad (*Isatis tinctoria*) is native to Europe and was introduced by some of the first immigrants to the Plymouth Colony in the early 1600s (Zouhar 2009). It was intentionally introduced to this region in the 1980s as a commercial crop by the Marlahan family in Scott Valley (this the local common name "Marlahan mustard," but it turned out to not be a viable commercial endeavor. The species quickly escaped cultivation, however, and has been rapidly spreading throughout the region ever since (Hesseldenz 2011 personal communication).

perennial pea (*Lathyrus latifolius*) is native to Europe. It has been planted as a garden ornamental and has escaped cultivation in many areas of California (DiTomaso and Healy, 2007).

American pokeweed (*Phytolacca americana*) is native to the eastern United States. This species spread from the southeast to California possibly through supplies brought out west from lumber and mining companies expanding into the region or via the distribution and use of it as a medicinal plant (Posey 2011 personal communication).

black locust (*Robinia pseudoacacia*) is native to the United States though the extent of its original range was thought to be east of the Rocky Mountains. It has been widely planted and frequently escapes cultivation (Stone 2009). Black locust was planted at the Ah-Di-Na homestead (less than two miles from the watershed boundary) approximately 100 years ago and has had a major impact within and around Ah-Di-Na Campground and various areas downstream within the riparian corridor (USDA Forest Service 1998).

Himalayan blackberry (*Rubus armeniacus*) is native to western Europe and was introduced to the U.S. as a cultivated crop. By 1945 Himalayan blackberry had become naturalized along the west coast of California (Bossard et al. 2000). It may have been intentionally planted at Ah-Di-Na and/or the McCloud River Club in the early 1900s (Hesseldenz 2011 personal communication).

Spanish broom (*Spartium junceum*) is native to the Mediterranean region and was introduced as an ornamental in the mid 1800s. By the 1930s was being prolifically planted along highways in southern California. By 1949 Spanish broom had spread northward to Marin County (Bossard et al. 2000).

Terrestrial Wildlife Species and Habitat

Prior to settlement in the mid 1800s, the transportation system consisted of trails associated with hunting, fishing, trading and other activities of the native inhabitants. Some early explorers and trappers passed through this watershed in the early 1800s (Henery 2008). The gradual extirpation of large carnivores such as the grizzly bear and gray wolf began as settlers moved into the area. Trapping and overhunting resulted in population-level declines of other furbearer species such as fisher, marten, wolverine, beaver and river otter.

Wildlife species that were restricted to special habitats (cavity nesters, bats) may have existed in greater numbers due to large expanses of habitat or the absence of the land use practices of the Europeans who were to follow. Large expanses of late-successional habitat prior to mechanized timber harvest practices offered habitat for species associated with this habitat type, though the landscape was most likely more open due to more frequent fire and subsequent lack of heavy fuels in the understories.

In the late 1800s, livestock grazing and homesteading began to change the native landscape. Attempts to extirpate wildlife species populations that were considered threats, such as the grizzly bear and wolf, continued. Elk were also extirpated, possibly due to overhunting as occurred with elk in the Trinity Alps (Henery 2008); however, elk were successfully reintroduced in 1911.

Changes to habitat most likely affected other species historical populations and distributions. A major contributor to the change in habitat was fire suppression. Fire suppression practices caused a decrease in populations of deer and other species that utilize early seral habitats. Conversely, fire suppression most likely contributed at least in part to an expansion of the distribution of many species that utilized late-successional patches found in the watershed (e.g. northern spotted owl, northern goshawk). Distribution and abundance of these species has also been influenced by multiple other factors including timber harvest of their original, occupied habitats, conversion of these habitats to other land uses, and changes to stand structure and overall juxtaposition of late seral habitats.

In addition, increased human activity through construction of roads and timber harvest, particularly in the northern portion of the watershed on private land, most likely contributed to a movement out of the general area or decline in habitat use for some species due to disturbance and exposure. Species that may have proliferated in the human-altered environments are expected to be more common today than before European settlement (Henery 2008).

Late-Successional Mixed Conifer Habitat

Pre-1900

Perhaps the largest scale influence to vegetation within the watershed prior to 1900 was recurrent wildfire. Typical fire severity and return intervals are discussed within the Fire and Fuels section of this watershed analysis and the impacts of these intervals are discussed in the Vegetation section.

Late-successional habitat was closely associated with major rivers and their tributaries. The remaining landscape consisted of more open forested habitats with early seral shrub or herbaceous understories, hardwood/conifer, oak woodland and chaparral habitats. Because of the open nature of much of the landscape, late successional species would have been associated with the stream courses and adjacent forested stands.

1900-1945

Settlement in the areas surrounding the Squaw Valley Creek, as well as the introduction of fire suppression techniques initiated habitat changes in habitats visible today. In the beginning, very small quantities of timber were likely harvested as a result of settlement, rather than marketing, as the watershed was not as accessible as much of the surrounding forested land. As fire suppression became more efficient, less of the land was maintained in an early-seral or open forested stage.

1945-present

Though fire suppression may have improved conditions for some species of wildlife, habitat may have become less suitable for other species as a result of an increase in dead/down wood, dense understories, increased canopy closure and the subsequent decline of shade-intolerant species. Excessive buildup of dead/down wood on the forest floor could inhibit visibility and accessibility of prey species for some avian predators. Dense understory regeneration by shade-tolerant species has the potential to obstruct movement of avian predators and decrease the overall species composition. Increased canopy would have led to a decline of oaks and other shade-intolerant species in the understory and subsequent decrease in structural diversity and palatable forage (such as mast and herbaceous vegetation) important to many wildlife species. However, the same increase in canopy closure and downed wood (and snags) would have also resulted in improved habitat conditions for species associated with late seral conditions such as fisher, marten, northern spotted owl, and goshawk.

With the increase in timber harvest in the 1960s, fragmentation of much of the late-successional habitat in the surrounding watersheds, in addition to the private lands within the watershed, increased, resulting in a reduction of habitat quality and overall suitability for species associated with these habitats. Some clearcut areas could have mimicked natural openings of early seral habitat, but at the cost of fragmentation. Harvest units were much larger than natural openings and were different in overall composition, particularly with their tendency toward single-aged monocultures and dense stocking. These differences could have significant long-term management implications and effects on fire behavior. This fragmentation impacted the late-successional species occurring there, but to what extent is not known, as no surveys were conducted before harvest activities at that time.

With the increasing harvest and fragmentation of larger amounts of older forests, a greater significance was then placed on the protection and promotion of larger blocks of contiguous late-successional habitat (i.e. Late-Successional Reserves, Riparian Reserves, and NSO Critical Habitat), as is currently present in the Squaw Valley Creek Watershed.

Early-Seral Brush / Browse Habitat

Pre-1900

Open chaparral and oak woodlands played a large role in supporting deer, small mammals (that served as both seed dispersers and prey for larger predators), and a wide variety of open habitat/early seral-dependent wildlife species. Hardwood and brush species grew more in the southern half of the watershed with patchy distribution elsewhere. Naturally occurring disturbances such as fire would have maintained forage in the form of herbaceous vegetation found amongst the chaparral and open forest understories. As the chaparral recovered, sprouting chaparral provided succulent, palatable forage. In undisturbed areas, mature chaparral produced berries and dense cover.

Oak woodlands supported hardwood-associated species such as the gray squirrel, band-tailed pigeon, acorn woodpecker, pallid bat, deer, turkey and black bear. Wildfires often burned relatively cool and kept the hardwood understory relatively open, stimulated acorn production and vegetative growth, and maintained shrublands in a mosaic of seral conditions.

1900-1945

Settlement was primarily in the northern portion of the watershed and fire suppression efforts were still developing. Habitat changes incurred from grazing and other human-caused disturbances continued. Wolf and grizzly bears were on the verge of complete extirpation, and dramatic declines in furbearing species and elk continued.

1945-Present

As fires were suppressed, chaparral became more decadent with time. Browsers were negatively affected as the browse became unpalatable and new growth became out of reach. In addition, as the brush became decadent, a smaller amount of habitat was available for small- to medium-sized mammals, as branches near ground level matured or died. Other species which fed on berries or used shrubs as cover (e.g. bears, birds and deer) benefited from the maturing browse (USDA Forest Servcie1998).

Within the oak woodlands, fire suppression reduced the amount of browse available in the understory in the form of mast, herbaceous growth or early-seral shrubs. Herbaceous growth may have been hindered since understory growth of shrubs and oak seedlings, usually tempered by frequent fire, would out-compete the herbaceous plants. Following this, shrub species in the understory would have matured and become unpalatable as browse (USDA Forest Service 1998).

Aquatic and Riparian

Pre-1900

Large runs of Chinook salmon and steelhead ascended the McCloud River and its larger tributaries including about five miles of Squaw Valley Creek, which was estimated to support over 800 redds (Yoshiyama et al. 2001). Coho salmon (*Oncorhynchus kisutch*) were also present but in much smaller numbers. Bull trout (*Salvelinus confluentis*) and rainbow trout, as well as Sacramento sucker (*Catostomus occidentalis*) and riffle sculpin, were common year-round river inhabitants (Moyle 2002). Native fish assemblages within the McCloud River were used by local Native Americans as an important source of food and cultural significance. Early European settlers who began to inhabit the area in the mid to late 1800s also relied on the fishery as an important food source.

Stream processes were likely functioning to provide excellent fish habitat. Bedload movement and large woody debris were in balance with channel functions and most likely provided an abundance of deep pools and runs. Under these conditions, large fish would have been common. Early human presence had little impact on the river and surrounding watersheds or on local fish populations, as human land alterations were small in scope and were associated primarily with homesteading and Native American use.

The gold rush of the mid-1800s attracted thousands of people to Shasta County and the upper Sacramento River basin. These miners and settlers capitalized on the fishery resources, for both personal and commercial consumption. The abundant runs of Chinook salmon were most impacted by these ventures. By the late 1800s, diminishing runs of salmon were noticeable in the Sacramento River. Thus McCloud River salmon populations were also diminishing due to a variety of increasing downstream impacts including fish canneries, logging, railroad construction, mining and smelting operations, and growing communities.

The McCloud River fishery gained considerable fame in the 1860s and 1870s for the prolific size of its salmon and steelhead runs, and the large size, beauty, and tenacity of its rainbow trout. In response, the U.S. Fish Commission established an egg-taking station at Baird on the lower McCloud River in 1872. During the early years of its operation, Baird Station was taking spawn from most all spring run salmon returning to the McCloud River to use for establishing salmon populations in the eastern part of the United States. From 1884 to 1887 Baird Station was closed due to a diminished salmon population but in response to the large declines in Sacramento River salmon populations, Baird Station was re-opened in 1888 to help maintain Sacramento River salmon runs. The egg station continued operation until 1935 at which time McCloud River salmon runs were significantly depleted (Yoshiyama et al. 2001). The site is now under Shasta Lake.

Wildland fires occurred regularly within the McCloud River drainage. They were part of the natural basin ecology and due to their recurrent nature, most likely helped maintain channel processes through the contribution of large woody material and coarse and fine sediment.

1900-1945

Changes to fish populations and aquatic habitat that began taking place in the late 1800s continued through the early 1900s. These changes were associated with fish hatcheries, fish canneries and commercial fishing, grazing, mining, timber harvest, and recreation. Logging operations were active along portions of the McCloud River to supply timbers to mining companies and railroad construction (Brown 1915).

Copper smelting was extensive in the early 1900s a few miles downstream from the mouth of the McCloud River. Smelting fumes destroyed large areas of forested vegetation and created a large fire hazard. High erosion rates from areas with no vegetation delivered large amounts of sediment to stream systems in the upper Sacramento River Basin. Erosion had become enough of a concern that control efforts were initiated in the 1920s and 1930s through reforestation programs (CDF 2005).

All these activities contributed to destruction of riparian vegetation, erosion of streambanks and accelerated sediment delivery to the Sacramento River system. These changes in stream morphology likely resulted in degraded aquatic habitat conditions and added to further declines in anadromous fish populations. At the same time, the development of fish hatcheries in Shasta County and the widespread practice of introducing non-native game fish to western waterways resulted in the introduction of other non-native fish species such as brown trout and brook trout.

1945-present

The completion of Shasta Dam in 1945 blocked the historic runs of salmon and steelhead from accessing the upper Sacramento River system including the McCloud River. The elimination of anadromous fish runs changed the ecology of the area by removing an important human food source, altering the fish community structure, genetically isolating rainbow trout, and disrupting the flow of nutrients that large runs of anadromous fish contribute to the natural food web. The dam resulted in simplifying and destabilizing the native fish community as it effectively blocked upstream and downstream migration patterns.

The creation of Shasta Lake converted stream environments into a lake environment. Fish populations that required stream habitats experienced habitat reduction, which caused local population levels to sharply decrease. The formation of a warm water lake fishery adversely affected native fish populations even more. Introduced warm water lake species such as bass and catfish moved into the McCloud Arm of Shasta Lake and further upstream into the lower reaches of the McCloud River. Non-native brown trout are now abundant in the analysis area. These introduced species often out-compete and prey on native species, further reducing their numbers.

The depletion of salmon runs, which served as a major food source for native bull trout, and the introduction of non-native trout species, which brought hybridization, competition, and predation to the bull trout population all contributed to this species' dwindling numbers (Moyle 2002).

By 1965 the construction of McCloud Dam blocked bull trout in the lower reaches of the McCloud River from swimming upstream to spawn and flooded 6 miles of prime bull trout habitat. Additionally, brook trout, which are known to hybridize with bull trout creating sterile offspring were introduced to the reservoir. McCloud Reservoir diverts about 80 percent of

McCloud River flows to the Pit River for hydroelectric production. As a result, the McCloud River downstream from the reservoir has significantly reduced flow levels, disrupted sediment regimes and raised water temperatures, all contributing to the final demise of the bull trout population in the McCloud River and Squaw Valley Creek. This impoundment, along with Shasta Dam, has permanently altered aquatic habitats in the analysis area.

Human Uses

Heritage Resources

Pre-1900

Native Americans have traditionally occupied the Squaw Valley Creek Watershed, as evidenced by prehistoric sites and linguistic evidence (see below). It is unknown how far back the prehistoric occupation of the watershed can be traced because of the general paucity of archaeological excavations or detailed linguistic research. Late period prehistoric sites with estimated dates of 1,500 to 1,000 years B.P. are within the watershed boundaries (generally midden and housepit village sites). The ethnographic references (Powers 1874, Dixon 1905, Merriam 1955, Dubois 1965, and Guilford-Kardell 1994a) that ascribe Tribal affiliation within the watershed indicate that this area may have been a transition area and that by the time of European contact, the area was occupied by people of mixed tribal affiliations. This included people who spoke the language of or were affiliated primarily with the Wintu, Pit River, and Shasta tribes, and secondarily the Modocs. Although the Okwanuchu are also rumored to have occupied this territory, the term "Okwanuchu" was a Shasta word meaning "South People" and it is completely uncertain whether this was actually a tribal entity (Merriam 1955).

The watershed boundary lies within the aboriginal territory claimed by the Winnemem Wintu, also known as the McCloud River Wintu. They were part of the northern reach of the overall Tribal group variously called the Northern Wintu, Wintu, Wintun, or Wintoon, Their territory stretched from the headwaters and South Fork of the Trinity River to portions of the Sacramento and McCloud Rivers, and included Squaw Valley Creek (Smith 1991).

Linguistic evidence in the watershed comes from Wintu place names. Tom Dow Creek was called “Khilimem” (Liverwater) in the Wintu language, and was used extensively as an east-west passage (Guilford-Kardell 1994a). Just west of the watershed boundary, the Wintu regarded the headwaters of Hazel Creek as a “special area” (Theodoratus 1985). Hazel Creek was known as “Dekipuiwakut,” and the nearby Tombstone Mountain was known as “Wenempuidal” or “Kele’s Mountain.” According to the Wintu, the feared “Keles” lived on Tombstone Mountain at the head of Hazel Creek, and all of Tombstone Mountain was their sweathouse (Curtin 1898). There is also “memthulin memyemer,” which is a Wintu place name for the top of the divide between Hazel Creek and Tom Dow Creek (Theodoratus 1985).

The earliest documented non-Native presence inside the watershed was during the 1800s when fur trappers, hunters, and miners explored the valley. Hudson Bay fur trappers first encountered the general area in the early 1800s, making their way down the Sacramento River canyon in search of otter and beaver pelts (Cranfield 1984). The American and Rocky Mountain Fur Companies are documented as having been in the general vicinity of the Sacramento Valley during the 1820s-1830s. Additionally, Roderick McLeod led a party of trappers through the area and along the McCloud River in 1827 (Wells 1881). The decline of the fur market brought the end of the trapper era in California by 1845, when the Hudson Bay Company withdrew from the region (Wells 1881). Few specifics regarding fur trapping within the actual watershed boundary are known, although it can be surmised from the above information that the trappers covered the area between the McCloud River and the Sacramento Valley.

The vicinity of Squaw Valley Creek, including Tom Dow and Tom Neal Creeks, was being mined as early as 1855, on a small scale by individual men. Many of these early miners lived with Indian women (Steger 1966), including the famous poet Joaquin Miller. Miller regularly traveled between Lower Soda Springs to the west of the watershed boundary and his cabin on Squaw Valley Creek, where he lived with a Wintu woman and other Native Americans during 1857 (Miller 1977). The influx of gold miners to the region brought additional use of the Squaw Valley Creek Watershed as well, and reported effects included the degradation of creeks, decrease in salmon and game animals, and the resulting food shortages for Native people who depended upon these resources (Miller 1977).

By 1887, the region surrounding the McCloud River was already known to surrounding communities for the excellent fishing and hunting opportunities, especially for trout, bears, and deer (North Star Newspaper July 1887). Access to the watershed for these activities was facilitated by early trails, some of which appear within the watershed boundary on the 1916 Shasta National Forest Map. Of note are the still-existing Tom Dow and Tom Neal Trails. These trails are presumably named for the creeks they traverse, which were named for well-known local men. Tom Dow was a French-Canadian hunter for the Salmon River Placer Mines, and was documented to have been “remembered as swinging jauntily along the street, rifle over his shoulder, on his way from the Denny Bar Company Store to the Burgess Saloon” (Guilford-Kardell 1994a). The Tom Dow Trail was cleared for fisherman access by Sim Southern, circa 1871 or later, from his resort on the Sacramento River to Hazel Creek, then over the ridge where it followed Tom Dow Creek to Squaw Valley Creek and the McCloud River (Guilford-Kardell 1994a). From here, the trail originally continued up Claiborne Creek and eventually to Big Bend on the Pit River. The Tom Neal Trail is reported to have been built by the Neal brothers during their tenure as fire lookouts on Girard Ridge. This trail originally connected the Castle Crags Trail to the Neals’ cabin near the mouth of Tom Neal Creek (Hesseldenz 2010 personal communication). According to the Shasta County Records, Thomas Neal filed for a water right on June 24, 1864 (Guilford-Kardell 1994a). Several historic camps and cabins have been documented along Tom Neal Trail, indicating the concentrated use of the surrounding area for hunting and fishing.

1900-1945

Private property inside the watershed is owned by the Nature Conservancy and the McCloud River Club. The McCloud River Club was originally organized on August 17, 1900, as the McCloud River Association. More than 4,000 acres along the McCloud River and Squaw Valley Creek were secured during the early 1900s for private recreational and conservation purposes (Volkmann 1951). A clubhouse was built at the junction of Squaw Valley Creek and the McCloud River in 1901. This burned down in 1904 and was replaced in 1905 by a much larger clubhouse that burned down in 1919. The next clubhouse was built further downstream, at a different location (Volkmann 1951). The clubhouse was originally accessed by trails through the watershed. A portion of the Tom Dow Trail was used from 1900 to 1910, until the construction of the road along Squaw Valley Creek was completed for access. Members and guests would travel by train to Sims on the Upper Sacramento River, then by pack mule along Hazel Creek and Tom Dow Creek to a cable bridge across Squaw Valley Creek (Hesseldenz 2010 personal communication). Later, the Club was accessed by a wagon road along Squaw Valley Creek. The road crossed three bridges over Squaw Valley Creek, then another bridge over the McCloud River before leading to the clubhouse (Guilford-Kardell 1994a). The upper six miles of the Club property along the McCloud River and a section of land in Squaw Valley Creek Canyon were donated to The Nature Conservancy in 1973.

In addition to private use, the watershed and surrounding areas have been utilized by the Forest Service since the creation of the Shasta Forest Reserve (later to become Shasta National Forest) in 1905. Fire fighting and limited grazing were primary uses of the land during that time. Grazing along Squaw Valley Creek is reported to have begun prior to 1887 (Guilford-Kardell 1994b). During the spring 1907, the Forest Service continued this practice by allocating a 62-section allotment north of the junction of the McCloud River and Squaw Valley Creek, between the McCloud River to the east and the Forest boundary to the north and west (Shasta Herald December 1907). Easier access to this grazing land was facilitated by the trails built during this time, which were constructed by the Forest Service primarily for fighting wildfires (Shasta Herald July 1908). Girard Ridge was first used as a fire lookout location circa 1908, when a cabin was built for this purpose on the southeast slope. It is not known if this lookout pre- or post-dates the forest fire reported near Squaw Valley Creek in 1908 (Shasta Herald August 1908). A Ranger Station labeled the "Cold Springs Ranger Station" appears along Squaw Valley Creek on the 1916 Shasta National Forest Map. The lookout on top of Girard Ridge appears on the 1926 Shasta National Forest (West Half) map as a "permanent lookout station." A telephone line also appears in 1926, stretching from the Cold Springs Ranger Station to the Girard Ridge lookout, then about a mile northeast of the lookout to a "triangulation station" on top of the peak located there. Other telephone lines can also be found along trails on the early Shasta National Forest maps.

1945-Present

Three barite mines located on Girard Ridge are depicted on the 1998 USGS 7.5' Dunsmuir Quad topographic map, in T. 38 N, R. 3 W, Sections 18 and 19. The mines are on private property, and little is known about their specific history. Barite was first mined in California in 1910 (Of et al 1912).The mineral rights to at least one of the mines in Section 19 were acquired by the Ralph L. Smith Lumber Company in 1953 (O.R. vol. 417). Sometime prior to 1962, the Baroid Division National Lead Company leased barite mines in Sections 18 and 19 from Glidden (Loftus) (Lydon and O'Brien 1974). Three potential mine scars can be seen on the 1944 DOD aerial photograph; these correspond to the mine locations plotted on the 1998 topographic map (Dunsmuir 7.5' USGS Quad), indicating the construction and use of the mines pre-dates 1944 and that the mines may therefore be historic sites. This cannot be field verified since the locations are not on Forest land.

Recreation Resources

Pre-1900

Recreation use in the Squaw Valley Creek Watershed began as early as the later part of the eighteenth century with the development of the trail systems and the travel routes used by the local landowners for fishing and hunting access. There was essentially no development of recreational facilities on the National Forest land within the watershed during this period. See the Heritage Resources discussion above for detailed information.

1900-1945

Private sport-fishing clubs along the river continued to develop during this period. In particular, the establishment of the McCloud River Club clubhouse in 1901, and subsequent buildings, increased recreational use within the watershed by trophy fisherman during this period.

1945-present

In 1973, the McCloud River Club donated 2330 acres of land to the Nature Conservancy, which formed the McCloud River Preserve, 560 acres of which fall within the Squaw Valley Creek Watershed. In 1986 the Forest Service recommended that Squaw Valley Creek be nominated for Wild and Scenic River status (LRMP p. 3-23). Further analysis showed that 10.5 miles of the creek is eligible for this designation however it is not currently recommended due to its adjacency to large parcels of private lands.

Caves

The extent of historic use of caves in the watershed is unknown. Many of the caves are overgrown with vegetation and have had little recreational activity in the past, most likely due to inaccessibility. Rumors of a cave on Tombstone Mountain date back to the early 1900s when anglers would use a backcountry route past the top of the mountain to access the McCloud River. A local caving group re-discovered this cave in the 1980s, and found old cans in the cave indicating prior visitation. The cave is not very extensive, nor does it have cave formations. This and other caves have been found and mapped by this caving group, which is part of the National Speleological Society and is dedicated to cave conservation (Hesseldenz 2011 personal communication).

Additionally, there is a concern of recreational cavers possibly increasing the occurrence of a bat fungal disease (White-Nose Syndrome). This fungus may be carried between caves on the shoes, clothing, or equipment of cavers. See the Terrestrial Wildlife Species and Habitat section for further information.

Transportation System and OHV Routes

Pre-1900

During this period only historic trails existed in the watershed. These were used by Native Americans until the late 1800's when Anglo-Americans began establishing presence within the watershed. As noted above, some roads were built in the watershed by private landowners who had been deeded properties pursuant to the Pacific Railway Act of 1862.

1900-1945

Some roads within the watershed were constructed during this time to aid in Forest Service activities such as grazing, and fire suppression activities. Many of these routes have had little or no maintenance and remain suitable for high clearance vehicles only. Some of these roads and trails were used to access recreation opportunities such as fishing.

1945-Present

Mining, timber harvest, and other activities have kept the roads maintained with some establishment of new roads during this period (most notably in the northern portion of the analysis area). In 1979 the Roadless Area Review Evaluation (RARE II) established the West Girard roadless area within the watershed. The 2001 Roadless Rule' (see Roadless Designation section) strengthened this situations by prohibiting new road construction and reconstruction in inventoried roadless areas on National Forest System lands except under specific circumstances.

Many of the transportation routes within the watershed are ridgetop jeep trails, some of which cross through private land. These routes have received little to no maintenance in the recent past. Limited access to these roads has created both recreation and management issues within the watershed (see Fire and Fuels section).

Visual Resources and Scenery

Visual and scenic quality remains nearly as high as during Native American occupancy due to limited alterations to the landscape through time. Dense old growth occupies much of the watershed and roads that were developed at the turn of the century are not highly visible from a distance. Fire has been largely absent within the watershed, resulting in a relatively unscarred landscape.

Chapter 5: Synthesis and Interpretation

The purpose of this chapter is to compare existing and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes. The interaction of physical, biological, and social processes is identified. The capability of the system to achieve key management plan objectives is also evaluated.

This chapter is organized by addressing the issues and core topics listed in Chapter 2. Additional topics that emerged during the analysis are included in this section.

Issues addressed in this chapter are:

- Fire and Fuels
- Habitat Quality
- Late Successional Reserve
- Access

Core Topics addressed in this chapter are:

- Physical Features
- Geomorphology and Erosional Processes
- Hydrology
- Stream Channel
- Water Quality
- Biological Features
- Vegetation
- Species and Habitats
- Human Uses

Fire and Fuels

Key Questions

1. What is the current fire hazard and risk in the analysis area, including the threat to private land?
2. How does the current fire regime impact vegetation within the analysis area?
3. How might future high-severity fires affect other resources (e.g.. air quality, erosion processes, human uses, soil fertility, water quality, fisheries, wildlife and botanical habitat)?
4. Under current management, what are the future trends for fire in the watershed?
5. What is the desired role of fire in the watershed?
6. What are fire and fuel management concerns within the analysis area, including fire suppression?
7. How does human usage within the watershed increase the potential for unplanned fires?

Present Condition

The analysis of fire return interval departure shows that much of the analysis area is in condition class 3. This indicates that a majority of the landscape has departed at least 66% from historic conditions and has missed approximately four or more fire return intervals when compared to historic occurrences. This brings a high risk of losing key ecosystem components, vegetation attributes and an increase in potential fire size, fire intensity and fire severity.

Conclusions that can be drawn from this analysis are:

- There are large areas of dense vegetation and high fuel loading above what is characteristic of historic conditions.
- There is a moderate fire start occurrence (fire risk) in the analysis area and the primary source of ignition (~74%) is lightning.
- Over 37,200 acres or 99 percent of the analysis area has not been visited by fire over the past 80 years.
- Approximately 35,000 acres or 93 percent of the analysis area is severely departed from historical fire return intervals.
- Approximately 52 percent of the area is subject to crown fire and 54 percent subject to moderate-to-high flame lengths under 90th percentile weather conditions.
- High intensity, stand replacing fire is the leading threat to other resources (i.e. wildlife habitat, air quality, soil stability, recreation, hydrology, air quality, etc) and private lands.
- Air quality is at risk in proportion to fire risk and high fire behavior potential.
- The likelihood of successful initial attack, especially during multiple start events, is greatly diminished by the factors mentioned above.

Causal Mechanism(s)

- Fire exclusion and other past land use management (e.g. lack of timber management on public lands, limited transportation system, etc.) have exacerbated the current problematic conditions.
- Site quality and productivity allow for fire intolerant species to thrive in the absence of disturbance and promote increases in fuel loading beyond historic levels. As tree stocking and density increases fuel ladders continue to develop.
- Limited public use of the analysis area has led to a reduced amount of human ignitions compared to nearby watersheds which often occur at unpredictable times and in unfavorable locations with respect to fire behavior.

Trends

- Through time, vegetation density and fuel loading has increased and will continue to do so without interruption by disturbance or management action. This has, in part, led to an increased likelihood of uncharacteristic fire behavior, fire intensity and fire severity in reference to historic conditions.
- There has been and continues to be a moderate fire start occurrence in the analysis area (an average of ~2 fire starts per year) with approximately 74% being naturally occurring ignitions and 26% being generated from human caused sources.
- Forest vegetation has changed from a heterogeneous pattern of mostly fire tolerant species to a more homogeneous pattern of smaller openings in a matrix of denser vegetation with increasing populations of fire intolerant species.
- Air quality is expected to be similar to that of recent years. Activities on NFS lands are guided by provisions of the Federal Clean Air Act, the Shasta-Trinity LRMP and the California Air Resources Board to minimize adverse effects to air quality. Periods of poor air quality are likely to occur during high-intensity fires; however, smoke particulates are expected to be less than before 1900.

Influences and Relationships

- Numerous fire starts coupled with steep terrain, limited access, dense fuel conditions and weather patterns conducive to large fire growth have caused difficulties in past fire suppression efforts. These conditions are a concern for land managers attempting to manage future wildfires within the analysis area.
- Vegetation type, disturbance history, soil type, fuels, topography and weather play a vital role in fire severity patterns on the landscape.
- Fire severity patterns on the landscape influence physical and biological resources (e.g. human uses, water quality, botanical resources and terrestrial and aquatic wildlife).

Conclusions

- There is a need to reduce fire risk and fire hazard in the analysis area.
- There is a need to protect communities at risk and the wildland-urban interface both within and adjacent to the analysis area.

- There is a need to provide for the management of fire within the analysis area to protect life, property and improvements as well as providing for the function of fire in the ecosystems.

Habitat Quality

Key Questions

1. Does the current condition in the watershed have a desirable mix of seral stages, age classes, and vegetation types of terrestrial habitat for wildlife species?
2. What management actions can be undertaken to improve conditions where they are not in the desired condition and protect habitats that are?
3. How are existing conditions influencing the potential for high-severity wildfire to impact wildlife habitat?
4. How are existing conditions influencing the potential for high-severity wildfire to impact botanical habitat?

Present Condition

- Very little management (e.g. timber harvest, prescribed burn) or fire has occurred on the federal lands within the watershed, resulting in extensive blocks of undisturbed habitat.
- Large, contiguous blocks of late successional habitat, of variable condition and quality, make up approximately 61 percent of the federal lands within the watershed.
- Mid seral habitat of variable condition and quality makes up approximately 29 percent of the federal lands within the watershed and contribute to the overall connectivity of the area.
- Relatively little oak woodland exists within the watershed, with the majority occurring in the southern and southwestern portion of the watershed.
- Areas of chaparral are being encroached by young dense conifers causing a loss of heterogeneity, and thus a loss of habitat richness, within the watershed analysis area. In some of these areas, the natural progression of seral stages has been hindered by the lack of fire that would otherwise contribute to the stimulation of new growth and the reduction in older, decadent brush within the understory.
- A small amount of early seral stage forest (hardwood and conifer) (<1%) occurs on the federal lands in the watershed. The quality and distribution of the early seral stands is dependant in large part on the position on the landscape, frequency and type of disturbance mechanism, soil type and site productivity.

Table 30. Brush/browse habitat and hardwood/oak woodland as represented within the Squaw Valley Creek Watershed.

Habitat Type (WHR Type)	Private land – acres	Percentage of private land in watershed	Public land – acres	Percentage public land in watershed
Mixed Chaparral (MCH) Browse habitat	14.16	0.09	503.49	2.18
Montane Chaparral (MCP) Browse habitat	168.70	1.16	366.81	1.59
Montane Hardwood-Conifer (MHC) Oak woodland/conifer mix; all size classes	1581.85	10.90	2588.03	11.22

Habitat Type (WHR Type)	Private land – acres	Percentage of private land in watershed	Public land – acres	Percentage public land in watershed
Montane Hardwood (MHW) Oak woodland; all size classes	177.60	1.22	1500.32	6.50

Table 31. Conifer and Hardwood Acres (and mixed) and early seral vegetation types compared to all acres in watershed on public lands.

WHR Size Class (DBH)	Seral Stage	WHR Density Class (% Canopy)				Total Acres	% Per Size Class
		S (10-24%)	P (25-39%)	M (40-59%)	D (60-100%)		
Grass; Barren; Lacustrine, etc.	Early seral conifer and hardwood combined	Density class not applicable (grass, barren, etc.)				23.55	0.10
Brush (MCP and MCH); size = X or 0		Density class not applicable to brush				871.78	3.78
1: < 1"		0.00	0.00	0.00	0.00	0.00	0.00
2: 1"-6"		2.56	1.70	10.13	127.83	142.21	0.62

- Good quality riparian habitat exists throughout the drainages and along Squaw Valley Creek within the watershed.
- In some mid and late seral conifer stands within the watershed fire suppression has resulted in a relatively dense middle story, which reduces maneuverability for predatory birds such as spotted owls and goshawks. A dense middle story can also result in reduced sunlight to the forest floor, which is essential for the production of an herbaceous vegetative layer important for sustaining prey species and plant diversity.
- Limestone caves in the area, and the bats that may occur within them, may be at some risk from recreational cavers, though to what extent is still unknown. It is possible that White-nose Syndrome (WNS) will appear in western caves and precautions may need to be made to proactively protect the caves known to be utilized by bats.

Causal Mechanism(s)

- Lack of low to moderate intensity fire
- Limited access
- Lack of management (e.g. fuels reduction) other than fire suppression (mainly initial aerial attack)
- Natural processes
- As a result of a lack of fire, many late seral stands are experiencing an encroachment of young dense conifers amongst large, widely spaced conifers and a subsequent loss of a

broadleaf middle story. In some areas this is resulting in a loss of optimal habitat structure for old-growth and late seral habitat associated species

Trends

- The shade tolerant, young conifer midstory, where present within these older stands, will continue to develop, competing with the larger overstory trees for water, soil nutrients, and sunlight, which may cause the overstory trees to become stressed and eventually die.
- Late seral stands will continue to mature, accruing large snags and downed logs as natural processes take place.
- Subsequently, fuels will continue to accumulate over time, increasing the vulnerability of the habitat to high intensity, stand replacing fire.
- Stands containing early seral brush/browse species will continue to become decadent, decreasing the palatability of the forage and increasing the risk of high intensity fire in areas containing dense woody debris and extensive brush skeletons; thus leading to a loss of important forage habitat (for species such as deer, elk, and prey species).
- Transfer of WNS fungus by recreationalists into caves within the watershed may affect the caves and the cave associated species in the future if the disease moves to caves in the west.

Influences and Relationships

- A lack of low to moderate intensity fire in the watershed has had many interconnected impacts on the habitat and species within the watershed.
- Stand structure has changed to the point of having extensive horizontal and vertical fuel ladders, making the watershed vulnerable to stand replacing, high intensity fire.
- Without the gradual introduction of fire back into the system, in the event of a high intensity wildfire, different types of change may take place:
    - A landscape level disturbance that resulted in the loss of encroaching conifers, from within primarily oak woodland or chaparral, would potentially return the area to a more natural condition.
    - However, in late seral stands that are filled in by dense, young conifers, a landscape-level disturbance event could be catastrophic to the desired goal of retaining and restoring late seral and old-growth habitat.
- Less intense wildfire can be beneficial in terms of hollowing-out trees and logs, producing charcoal which helps hold soil nutrients, killing conifer seedlings and saplings that would otherwise continue to grow and shade out important understory species, and rejuvenating fire-tolerant herbaceous and browse species, as well as the fuels related issues described in the Fire and Fuels section above.

Conclusions

- There is a general lack of site specific data regarding the current suitability of the habitat that is being described as late and mid seral for species associated with this habitat, such as northern spotted owl and goshawk.
- On the ground habitat verification and species specific surveys would help to identify areas that are currently being used by species of special concern. These areas could then be prioritized for either management actions and/or protection.
- Data regarding the caves in the watershed is incomplete in so far as comprehensive and current account of what species of bat are using the caves and the role the caves play in the bats' lifecycle.
- Data are also needed to determine to what extent these caves are being used by recreational cavers and what precautions are necessary to protect against the spread of WNS.

Late Successional Reserve

Key Questions

1. What is the current condition of the LSR in the watershed?
2. What is the current risk to the LSR? How can the risk be reduced?
3. What is the desired role of fire in the LSR?
4. What is the future trend for development, maintenance and protection of late-successional habitat in the LSR?
5. How does the Iron Canyon LSR meet the criteria for prioritizing treatment areas both within the LSR network as a whole and as within individual LSRs as outlined in the forest-wide LSR Assessment?
6. What is the role of the Squaw Valley Creek Watershed in the functioning of the Iron Canyon LSR as a whole?

Present Condition

- Large, contiguous blocks of late successional habitat exist in the watershed.
- Much of the late successional habitat in the watershed is high quality habitat for the northern spotted owl and other old-growth and forest interior dependent species.
- The Iron Canyon Late-Successional Reserve (LSR RC-335) encompasses approximately 99% of federal ownerships within the Squaw Valley Creek watershed.
- The Iron Canyon LSR encompasses approximately 87,674 total acres, 26 percent of which is located in the Squaw Valley Creek Watershed.
- The Iron Canyon LSR, including Squaw Valley Creek watershed, was identified within the LSRA as an area of elevated risk to large-scale disturbance due to changes in the characteristics and distribution of the mixed-conifer forests resulting from past fire suppression.
- Seventy-seven percent of the acreage within the Iron Canyon LSR (68, 639 acres) was identified as at risk of high mortality (e.g. stand-replacing) in the event of an unplanned wildfire.
- The Iron Canyon LSR was identified as being at 66 percent of the expected late-successional sustainable level with 25,298 acres in size class 4 (i.e. 25-40” dbh) or above.

Causal Mechanism(s)

- Lack of low to moderate intensity fire
- Limited access
- Lack of management other than limited fire suppression

- Natural processes

Trends

- High severity/high intensity wildfire has been identified as the greatest threat to further loss and degradation of habitat for late-successional associated species within the network of LSRs.
- Late seral habitat is will continue to provide connectivity within the Iron Canyon LSR itself and within the network of LSRs as a whole.
- Mid seral habitat within the LSR will continue to develop into later seral stage habitat and will continue to contribute to the overall lack of fragmentation of the watershed.

Influences and Relationships

- The Squaw Valley Creek watershed is one of six watersheds within or crossing the Iron Canyon LSR.
- Squaw Valley Creek watershed plays a vital role in the connectivity and functioning of the Iron Canyon LSR and the LSR network as a whole due to its general lack of fragmentation and the overall contiguous nature of the late seral habitat.
- The Iron Canyon LSR, including the Squaw Valley Creek watershed, is centrally located within the network of LSRs in the Shasta-McCloud subprovince, with some of the largest blocks of contiguous habitat in the network, placing a high level of importance on the protection and enhancement of the current and future habitat within the area.

- Of the 24 LSRs analyzed on the Shasta-Trinity NF, the Iron Canyon LSR was one of the top four LSRs identified as having the greatest sustainable level of late-successional forest and that also has the highest risk.
- Management objectives for LSRs involve specific actions designed to improve, promote, and protect late-successional forest ecosystems. Protection includes reducing the risk of large-scale disturbance, including stand-replacing fire, insect and disease epidemic, and major human caused impacts. Risk reduction efforts are encouraged where they are consistent with the overall recommendations in the management guidelines of the LRMP.

Conclusions

- In order to close the gap between what the current trends are and what the management objectives for the area are, more data is needed to more thoroughly evaluate current on the ground conditions.
- Where ground conditions are known, a plan for achieving management goals that include a return to more historic fire return intervals should be established for the long term sustainability of the LSR as a whole.
  - There is a need to reduce to risk of high intensity, stand replacing fire in the watershed so that the watershed may continue its current role of providing large

blocks of late seral habitat, and the continued development of mid seral habitat into later seral stages.

- Fragmentation is not inhibiting the functioning of this LSR.

Access

Key Questions

1. How does a lack of access affect wildlife and rare plant species and habitats?
2. How does access affect noxious weed spread within the watershed?
3. How does a lack of access influence land management and land use practices, fire suppression capabilities and fuels and vegetation treatment activities?
4. How does a lack of access affect human uses and recreation?
5. How do the land allocations and designations in the watershed affect access into and within the analysis area?

Present Condition

Access into and within the Squaw Creek Watershed analysis area is limited. Some roads and trails are not in sufficient condition to facilitate increased use. Access concerns may also vary depending on where roads are located (i.e. top or bottom of slope); seasonal restrictions (e.g. wet or winter weather closures), slope grade, road material type (gravel vs. paved), road width, etc. Limited access facilitates limited management (e.g. timber harvest, fire suppression) and recreational (e.g. hiking, camping, fishing) activities within the watershed analysis area. For example, some roads or bridges are too narrow for engines, crew hauls, or equipment transports in the event of such fire suppression needs. Alternative transportation system opportunities (e.g. helispots, jumpspots or OHV routes) either already exist or have the potential for development within the watershed analysis area.

Causal Mechanism(s)

- The watershed analysis area is remote and relatively far from major roads or highways.
- There are many private landholdings which restrict use (e.g. via gates, permit requirements, etc.)
- Trails (e.g. Tom Dow and Tom Neil) are unmaintained.
- Steep terrain makes off-road/off-trail travel, as well as new road or trail construction, difficult.

Trends

- There will continue to be limited use of the watershed for recreation and management purposes due to the difficulty of accessing the area (via road or trail).
- Threats to species of concern (i.e. sensitive wildlife or plant species) via trampling, poaching, or other human uses will remain low.
- Noxious weed introduction or spread will remain low.
- Fire suppression opportunities will continue to be limited.

Influences and Relationships

- Trail and road maintenance affect recreational use and management of the watershed analysis area having both positive and negative effects.
- Private landowners have an effect on public use of the watershed analysis area.
- Natural features of the area (e.g. steep terrain) limit access.

Conclusions

- There is a need to improve access into and within the watershed analysis area for recreation and management (e.g. fire management efforts).
- There is a need to evaluate the potential effects of increased visitor use within the watershed analysis area if access is improved.
- There is a need to consider the methods for increasing access into the watershed and the potential resultant effects on wildlife, plants, and other species of concern.

Geomorphology and Erosional Processes

Core Questions

1. What are the natural and human causes of changes between historical and current erosion processes in the watershed?
2. What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment)?

Present Condition

- Dormant and active landslides are very uncommon, relative to adjacent watersheds.
- Based on existing inventories and a reconnaissance air photo examination, human activity has had little effect on landslide processes in the analysis area. No direct evidence of road or harvest-related landsliding was identified. However, there may be increased surface erosion occurring in the upper third of the watershed associated with timber harvest and roads.
- Steep headwall basins in the lower two thirds of the watershed are capable of generating debris flows if burned at high severity and subjected to intense post-fire precipitation.
- Karst areas are vegetated (except in outcrop areas) and have not been subjected to severe fire or timber harvest in the recent past (except for a small fire on Tombstone Mountain in the 1980's).
- Caves are known to exist in the analysis area, but the Forest currently has no data on the condition of these caves or any possible human effects.

Causal Mechanism(s)

- Road construction
- Logging
- Wildland fire
- OHV use
- Steep, headwall basins with shallow soil cover

Trends

- Risk of large, high intensity fires in the area is increasing. This in turn could dramatically increase landslides and debris flows. This risk could also affect the cave resources that do not occur on bare outcrops .

Influences and Relationships

- Landslides, debris flows, surface soil erosion, and karst processes are naturally occurring within the analysis area. The steep terrain of the Klamath Mountains is actively eroding, (primarily through landsliding), but at a lower rate in the recent past than in adjacent watersheds. Human influence has been very limited in the lower two thirds of the analysis area, but timber harvest and roads are present in the upper part. Disturbance from activities such as road building and logging that occur are mitigated by the implementation of best management practices on National Forest lands, and California state timber harvest regulations on private land.

- Wildland fire is also a natural component within this system, but has been very rare in the recent past relative to adjacent watersheds. Suppression of fires may have reduced erosion for intervals where fire would naturally have occurred. Fire suppression in many areas has resulted in conditions conducive to larger, more severe fires in the future, which would likely increase landslide rates.
- The level of past and present human use of caves within the analysis area is unknown. Improved access can result in greater human visitation to caves, and increased potential for vandalism.

Conclusions

- Human activity has had little effect on recent landslide rates, but may have increased surface erosion.
- The analysis area is at risk for large, severe wildland fires, and such an occurrence would increase landslide potential.
- Caves and associated resources evolved with wildfire, and the prescribed fire can be managed to mimic wildfire.

Hydrology

Core Questions

1. What are the natural and human causes of change between historical and current hydrologic conditions?

2. What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g., sediment delivery, fish migration)?

Present Condition

- Roads and settlements increase water delivery; therefore, peak flows are higher in sub-watersheds with high road densities and high concentrations of impermeable surfaces.
- Peak and baseflows in tributaries to Squaw Valley Creek have likely not changed appreciably from reference to current conditions exhibiting low road densities.

Causal Mechanism(s)

- Relatively low density of road systems in several of the drainages (HUC7) in the analysis area.
- Lack of development in large portions of the analysis area.
- Absence of large impoundments or diversions on streams in the analysis area.

Trends

- Future road construction in the analysis area is likely to be minimal.
- The three lower drainages (HUC7) in the analysis area are primarily administered by the Shasta-Trinity National Forest; they are largely untrammeled and are likely to remain in this condition.
- Interest in consumptive water uses by private industry could alter hydrology in the analysis area.

Influences and Relationships

- Increased development (i.e. roads, subdivisions) may increase runoff rates and volume.
- Wildfires tend to burn at higher intensity and result in higher severity than prescribed fire which is typically implemented during cooler and wetter conditions. Both situations have potential to affect runoff rates and peak flows; however, affects from prescribed burns are expected to be smaller magnitude and shorter duration than those of wildland fire.
- The diverse habitat, geology, and other biological features found in federally managed drainages within the analysis area are unique and ecologically valuable. The lack of human influence to this area, as well, is notable.

Conclusions

- The pristine conditions in the lower drainages that are federally managed are ecologically valuable. These pristine conditions serve as a benchmark for restoring reference conditions to the watershed.

- There are opportunities for formation of partnerships between the Forest Service and private landowners to study the area.
- There are opportunities for restoration to restore hydrologic reference conditions within the analysis area.

Stream Channel

Core Questions

1. What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed?
2. What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

Present Condition

- The main stem of Squaw Valley Creek has downcut during the last century, degrading the stream channel condition and resulting in high sediment transport and bank erosion. Meadow restoration has occurred on private lands - particularly within the Willow Creek Ranch area in the northern portion of the watershed analysis area.
- The stability of upland stream channel types has increased in areas where fire has been effectively suppressed resulting in accumulation of fuels and increased risk of future high-severity wildfires with the potential for adverse affects to stream channel stability..
- Larger streams have been impacted by sediment sources from roads located within and adjacent to inner gorges.
- Stream stability in areas with high density roads has been reduced.
- Channels in drainages with higher road densities (i.e. Willow Creek-Squaw Valley Creek and Pig Creek-Dairy Creek Drainages) are generally more altered by human use. The impacts typically include decreased stream stability, increased scour, and change in substrate (i.e. higher percentage of fine sediments).
- Many stream channels reflect changes related to fire and fuels and changes in vegetation structure and composition.
- Mass wasting naturally occurs within the analysis area. Land use activities have the potential to increase both the frequency and magnitude of mass wasting.
- Many upland channels within the analysis area remain unsurveyed.

Causal Mechanism(s)

- Road construction and other features such as subdivisions that create impermeable surfaces and alter hydrologic response
- Wildfire and fuels management
- Lack of data for stream channels that have not been surveyed due to remote and rugged terrain

Trends

- Road construction on public land is not expected to change.
- Road density and other developments on private land will likely increase in a trend consistent with the last 25 years.
- Effects from wildfire are likely to increase unless changes in fuels management are implemented.

Influences and Relationships

- Properly managed riparian reserves protect water quality and provide biologically diverse areas.
- Stream channels can funnel air flow, thereby increasing fire intensity and the severity of fire effects to the environment.
- Hillslope erosion following high-severity wildfire can deliver large volumes of sediment to the upland channel network.
- High-intensity wildfire in Riparian Reserves destroys large woody debris and hinders the ongoing recruitment of large woody debris until large trees become re-established.
- When stream channels are destabilized by high-severity wildfire, riffles tend to elongate resulting in a loss of pools and deep water habitat.
- High-intensity wildfire in Riparian Reserves removes riparian vegetation that is critical to bank stability.
- Increased sediment loads following large wildfires result in a loss of spawning habitat.
- Road construction increases sediment delivery and transport into colluvial and bedrock channels.
- Proper management of LSRs encourages development of vegetation conditions that improve slope and bank stability.
- Properly managed LSRs provide an ample source for the long-term recruitment of large woody debris in Riparian Reserves.
- The formation and maintenance of habitat features, such as deep pools and runs are, critical to the production of large and mature trout.

Conclusions

- Stream channels may be more severely impacted by wildfire if fuels accumulations in Riparian Reserves are not reduced.
- Several stream channels impacted by past road construction would benefit from road reconstruction or relocation.
- Resource managers need additional stream survey data to effectively manage the watershed.

Water Quality

Core Questions

1. What are the natural and human causes of change between historical and current water quality conditions?
2. What are the influences and relationships between water quality and other ecosystem processes in the watershed (e.g., mass wasting, fish habitat, stream reach vulnerability)?

Present Condition

- There are no 303d listed impaired waters in the Squaw Valley Creek analysis area.
- High levels of dissolved organic carbon (DOC) are suspected in several tributaries in the analysis area.
- Water quality in several streams may be affected by sediment loading due to high road densities and other human disturbance.
- Water quality is at risk of high sedimentation from high-severity wildfires.

Causal Mechanism(s)

- High levels of dissolved organic carbon may be from anthropogenic or natural sources
- High road densities
- Ongoing fire suppression resulting in unnatural accumulation of fuels

Trends

- Overall water quality is expected to remain high in the absence of large, high severity fires.
- Effects from wildfire are likely to increase unless changes in fuels management are implemented.

Influences and Relationships

- Land use activities that create disturbance can increase turbidity.
- The risk of large, high intensity fires in the area is increasing. Large fires with high proportions of high intensity, such as the Jones Valley Fire, would impact water quality by increasing suspended sediment and turbidity.
- Hillslope erosion following high-severity wildfire can deliver large volumes of sediment to the upland channel network.
- Large fires result in the formation of ash, which can increase the pH of streams.
- High-intensity wildfire within Riparian Reserves removes riparian vegetation that is critical to maintaining cooler water temperatures.
- Properly managed LSRs and riparian reserves provide greater crown cover that reduces water temperatures.

Conclusions

- Stream channels may be more severely impacted by wildfire if fuels accumulations in Riparian Reserves are not reduced.
- More water quality data are needed to assess and effectively manage water quality conditions in tributaries to the McCloud River.
- Water quality is expected to remain high in the absence of widespread disturbance such as high-severity fire.

Vegetation

Vegetative conditions in the watershed have changed from a heterogeneous to a more homogeneous distribution of age classes across the landscape. Early seral vegetation, on a stand level, is currently nearly absent and there is a lack of active recruitment of new cohorts of trees. Lack of significant tree harvest and active fire suppression has resulted in this shift to a landscape of homogeneous age classes. Diversity on a local and landscape scale is less than during historic conditions.

Core Questions

1. What are the natural and human causes of change between historical and current vegetative conditions?
2. What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed?

Present Condition

- Plant succession, coupled with aggressive fire suppression, has resulted in areas of dense vegetation.
- Over ninety percent of the watershed is in mid and late seral conditions.
- Mid-story broadleaf trees such as oaks are being shaded out.
- Shrub species are generally being excluded due to conifer encroachment.
- Species composition has shifted toward more shade tolerant species.
- Understory development is trending toward conifers, and is excluding shrubs, forbs and grass species.

Causal Mechanism(s)

- Fire exclusion
- Site quality
- High precipitation

Trends

- Early successional habitats will remain limited
- Limited seral stage and age class diversity on a stand and landscape level
- Abundant representation of conifer species will continue, limiting other plants (broadleaf trees, shrubs, forbs, grasses)
- Late seral vegetation will increase in density

Influences and Relationships

- The potential for large scale disturbance will increase. Disturbances that could have a landscape level effect include unplanned fire, insects and disease.
- In the event of a very high severity wildfire, vegetation mortality may be severe to extreme. Homogeneous vegetative conditions on such a large portion of the landscape increase the

risk of stand and landscape level vegetation replacement fires. The result could be a landscape that is lacking seed sources from conifers.

- LSR land allocation emphasizes the maintenance of late-successional forest.

Conclusions

- The vegetation condition in the watershed influences wildlife habitat, fuel loads and forest structure.
- Fuels reduction work would assist in supporting old forest conditions that have developed largely as a result of fire suppression.

Species and Habitat

Core Questions

1. What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern in the watershed?

2. What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

Threatened, Endangered and Sensitive (TES) Plants and Other Species of Concern

Present Condition

Populations of sensitive plants are known to occur within the watershed analysis area. Rare plant habitat is present however it may be declining. Some existing habitat may be threatened by potential very high-severity wildfires. Other habitat, however, may benefit from fire. Human disturbance within the watershed does not currently play a large role in the threats to these botanical species of concern. Although a few surveys for rare species have occurred in the watershed, a comprehensive inventory for rare plant, fungi, lichens, and bryophytes, is lacking.

Causal Mechanism(s)

- Rare plant habitat is imperiled by fuels accumulation from fire suppression. Many rare species rely on forest openings and may be limited in reproductive capabilities due to a dense overstory condition.

- The mechanisms behind rare species' responses to various fire frequencies, intensities, or severities are not well documented. Some generalizations, however, have been observed:

    - Species with deep rhizomes, such as English greenbriar, or bulbs, such as Butte County frittilary, may persist or flourish after prescribed fire or wildfire. For example, a 2006 study (USDA Forest Service) showed Butte County fritillary as having "no apparent change in population" after a spring underburn was implemented.

    - Species which have evolved with low- to moderate intensity fire (e.g. mountain lady's slipper [Vance 2007]) may benefit from similar conditions created by prescribed burns.

    - Late successional associated plant species (e.g. Pacific fuzzwort) may be negatively impacted by a high severity stand-replacing fire due to loss of necessary large-diameter trees, adequate shading, etc.

- Past human-caused disturbances such as road and trail construction, grazing, and some mining and logging may have contributed to a lack of rare plant habitat. Competition from noxious weeds may be displacing rare plant species.

- Access to the watershed for recreation (hiking, OHV, camping, etc.) is limited (see Access and Human Uses sections) therefore direct impacts such as trampling or poaching of species on public lands is not of serious concern at this time.

Trends

- The risk of very high-severity fire – and thus its potential negative impacts to rare plant populations and suitable rare plant habitat – has increased with fire exclusion and in the absence of treatment of accumulated fuels.
- The risk of negative impacts to rare species from human disturbance within the watershed is not markedly increasing.

Influences and Relationships

- High-severity wildfire can extirpate rare plant populations and result in temporary loss of rare plant habitat. Continued accumulation of untreated fuels in the watershed will increase the risk of high-severity fire.
- Reduced sunlight in the absence of disturbance results in habitat loss for some rare plant species.
- Although recreation use in the analysis area is relatively low, human activities such as OHV use, hiking, driving, and camping may threaten rare plant populations and habitat through direct trampling, soil compaction and/or introduction and spread of noxious weeds.
- Competition from noxious weeds may displace rare plants.
- Protection measures that maintain the viability of rare plant populations during Forest activities increase the likelihood of their survival.

Conclusions

- Appropriate management of fuels to maintain or enhance habitat conditions for known rare plant occurrences will likely promote stable or increased population numbers of these plant occurrences within the watershed.
- Properly managed human activities within the watershed analysis area (e.g., OHV use, camping, hiking, and fishing) will continue to have little negative impacts to rare plants.
- Surveys for sensitive plant, lichen, fungus, and bryophyte species are needed in the majority of the watershed. here

Noxious Weeds

Present Condition

Several noxious weed species have established in the watershed and may possibly increase in abundance and distribution. These documented weeds occur primarily along the Squaw Valley Creek Road within the watershed analysis area. No known weed populations are known to be directly competing with native rare plant species however they are competing with native vegetation.

Causal Mechanism(s)

Causal agents for the introduction of specific individual noxious weed populations in the watershed are unknown. Several species, however, may have been introduced through animal dispersal, road building, grazing, logging, or other human activities within the watershed analysis area. Additionally, four wildfires in the watershed analysis area (see Map 15-) created openings in the forest canopy where invasive species may have established; however, without surveys this information is unknown.

Trends

- Non-native species exist in the watershed. These species' populations will continue to increase if no or insufficient weed-removal plans are implemented.
- Insufficient funding does not permit a systematic program to effectively deal with invasive species removal presently.

Influences and Relationships

- Species such as Himalayan blackberry, yellow star thistle, or invasive broom species (e.g. French broom, Scotch broom) may outcompete and thus diminish available browse for wildlife.
- Broom species may increase fuel loads and fire risk.
- High-severity wildfires increase the risk of introduction and spread of noxious weeds.
- Ecosystem function in the watershed may be negatively affected by noxious weed invasion via changes in the fire regime. For example, broom species form dense stands which burn readily and may carry fire into the canopy, increasing the intensity and frequency of fires in the watershed.
- Human activities such as road maintenance, OHV use, hiking, driving, and camping act as vectors for the spread of noxious weeds.

Conclusions

- Yellow star thistle, Himalayan blackberry, broom species, perennial pea and thistles are likely to spread in the watershed analysis area and will continue to compete with native species if active weed management is not implemented.
- Black locust occurring in riparian areas may spread in this ecotype. New populations may establish at higher use recreation areas (e.g. Cabin Creek Trail) but likely will not encroach into sufficiently dense (i.e. shaded) conifer stands.

Terrestrial Wildlife Species and Habitat

Present Condition

- Current habitat quality and species distribution has changed from historic conditions due to a general change in stand structure due, at least in part, to a lack of low to moderate intensity fire and the subsequent growth of a dense conifer midstory, a more tightly closed overstory and an accumulation of large amounts of dead and down woody debris in the form of either logs or brush skeletons.
- Habitat for late seral species such as the northern spotted owl, goshawk, marten and fisher currently exists in the watershed and is of variable quality, depending on factors such as position on the slope, aspect, site productivity and last occurrence of a disturbance mechanism (e.g. fire, wind event, landslides, or flooding).
- Habitat for species associated with limestone, caves and rock outcroppings (such as Shasta salamanders, bats, and mollusks) exists in the watershed - though to what extent is not completely known.
- Surveys for federally listed or FS Sensitive species have not been conducted within the majority of the watershed, with the exception of specific areas for northern spotted owls.
- There are both known locations and unconfirmed sightings for federally listed and candidate species within the watershed; four northern spotted owl activity centers; one confirmed sighting of a fisher; and unconfirmed sightings of wolverine.
- There are both known locations and sightings of Forest Service Sensitive species within the watershed; one unconfirmed bald eagle nest; a historic goshawk nest record for one location; willow flycatcher sightings (on private land and directly adjacent national forest land); confirmed northwestern pond turtle sightings; confirmed Shasta salamander sightings; and one unconfirmed sighting of Townsend's big-eared bat.
- The Squaw Valley Creek watershed includes portions of Critical Habitat Unit (CHU) #CA-4/CHU 28 (Eastern Klamath Mountains) Subunit 77 for the northern spotted owl, and was seen by the Interagency Scientific Committee (ISC) as the best opportunity to create a large habitat conservation area in the Shasta-McCloud subprovince.
- Limestone caves in the area, and more specifically the bats that may occur within these caves, may be at some risk from recreational cavers, though to what extent is still unknown. It is possible that White-nose Syndrome (WNS) will appear in western caves and precautions may need to be made to proactively protect the caves known to be utilized by bats.

Causal Mechanism(s)

- Lack of low to moderate intensity fire
- Limited access
- Lack of management other than limited fire suppression
- Natural processes

- Transfer of WNS fungus by recreational cavers into caves within the watershed may affect the caves and the cave associated species if the disease spreads to caves in the west.

Trends

- As natural processes take place, late seral stands will continue to mature, and large snags and downed logs will accumulate, causing an increase in habitat for species associated with large woody debris, such as forest carnivores (fisher, marten, etc.) and prey species (wood rats, rodents species, etc.).
- Subsequently, fuels will continue to accumulate over time, increasing the vulnerability of the habitat to high intensity, stand replacing fire and the potential loss of large blocks of late seral habitat.
- Stands containing early seral brush/browse species will continue to become decadent, decreasing the palatability of the forage and increasing the risk of high intensity fire in areas containing dense woody debris and extensive brush skeletons, leading to a subsequent loss of important forage habitat (for species such as deer, elk, and prey species).

Influences and Relationships

- Timber harvest has not influenced the relationships of species and their habitats in the public portion of the watershed as much as other adjacent areas or as on private lands, as very little harvest has occurred on the federal lands in the watershed.
- The CHU is one of the keys to maintaining the viability of the subprovince and providing a source population for northern spotted owls, and is considered in the LSR Assessment as one of the most important CHUs to protect in the subprovince.
- The CHU is a vital area for providing linkage and connectivity, and an opportunity for genetic interchange between the northern and California subspecies.

Conclusions

- Due to the increased level of importance placed on the Critical Habitat Unit within which the Squaw Valley Creek Watershed occurs, management should focus on activities that are compatible with the objectives of enhancement, protection, and promotion of the high value habitat present within the watershed.
- A lack of comprehensive surveys in the watershed prevents managers from providing site specific recommendations geared toward the enhancement or protection of a specific species and its associated habitats.

Aquatic and Riparian

Present Condition

- The construction of Shasta Dam and creation of Shasta Lake blocked federally listed anadromous salmon and steelhead from their historic range in Squaw Valley Creek. The Bureau of Reclamation and other federal and state agencies are examining the possibility of re-introducing Sacramento River spring run and winter run Chinook salmon into historically occupied habitats above Shasta Dam.
- Shasta and McCloud Dams led to the demise of bull trout in the McCloud River. It is likely that bull trout were also found in the lower reaches of Squaw Valley Creek.
- Aquatic mollusks that are either listed on the Regional Forester's October 15, 2007 Sensitive species list or listed as Survey and Manage Species under the Northwest Forest Plan potentially occur in the analysis area.
- Squaw Valley Creek and its perennial tributaries provide consistent year-round flows fed by cold water from Mount Shasta snow melt and natural springs. Stream habitats are generally high quality with cool water refugia, functioning riparian areas, adequate instream cover, and a variety of pool habitats. However, the condition of specific aquatic habitat parameters is largely unknown as these habitats are mostly unsurveyed.
- Stream habitats are dominated by both native and introduced trout species that provide popular sport-fishing opportunities. These resident trout species utilize t Squaw Valley Creek for all phases of their life cycle.
- Current and accurate aquatic species range and location information is generally lacking in the watershed.

Causal Mechanism(s)

- Construction of Shasta Dam and the subsequent creation of Shasta Lake – as well as construction of McCloud Dam – has fundamentally altered aquatic habitats and aquatic species communities in the McCloud River. As a result, aquatic habitats and aquatic species communities have also been altered in Squaw Valley Creek.
- Current and historic natural and human-caused disturbances that have had the most influence on habitat conditions within Riparian Reserves are fires, floods, grazing and timber harvest. With little timber harvest and grazing activity, and relatively low road densities, the current greatest threat to the function of Riparian Reserves in the analysis area is high intensity fire. Fire suppression has led to increased upland stand densities, which has contributed to less frequent but higher severity fires across the landscape. These high-severity upland fires have burned through Riparian Reserves with similar intensity.

Trends

- Current fish populations within streams are expected to remain stable. Aquatic and riparian-dependent species habitat will fluctuate in response to future disturbances such as fires and floods.
- Aquatic mollusk species of concern are expected to remain stable as long as their perennial spring habitats remain undisturbed.

Influences and Relationships

- Localized cold spring complexes and spring-fed cold, clear waters with low amounts of fine sediments are critical for maintaining populations of sensitive and survey and manage aquatic mollusk species.

- Successful recovery efforts for aquatic species of concern will conserve and restore the long-term dynamics of watersheds, rather than just habitat attributes. Meeting any given management imposed habitat standard may or may not reflect the health of a stream or spring system. Maintenance of critical stream processes, such as the flow regime; sediment, woody material delivery, and riparian vegetation are more likely to result in the successful conservation of aquatic and riparian-dependent species. Riparian Reserve designations and the Aquatic Conservation Strategy were designed to protect these critical stream processes.

- Fire impacts to vegetation within Riparian Reserves can be highly variable and are dependent on a wide variety of factors including fire intensity and behavior, fire weather, vegetation type, vegetation density and age, topographic factors (e.g. slope, aspect, and elevation), and local soil moisture conditions. Riparian Reserves at the greatest risk of loss from high and moderate burn intensities are upland ephemeral and intermittent stream drainages. Fires in upland areas generally burn swales and ephemeral and intermittent stream channels at the same intensities as the adjacent hillslopes because of dry summer conditions that deplete moisture and create favorable conditions for fire (Skinner 1997). Being of higher gradient, they also contribute to a chimney effect of fire being drawn up ravines. Generally large perennial channels burn at low intensity and have little hardwood and conifer mortality.

Conclusions

- Survey information for aquatic species of concern is needed to accurately plan for future projects proposed in the analysis area.

- Carefully planned vegetation management treatments will move Riparian Reserves towards desired conditions as well as benefit multiple species.

- Within the Squaw Valley Creek Watershed, effects of a potential future high severity wildland fire on Riparian Reserves would heavily decrease the functioning of riparian and stream habitats within the Reserves. Vegetation treatments within Riparian Reserves, including prescribed fire, may be appropriate to protect them from future high intensity wildfire. Reduction of heavy fuel loads within the watershed would help attain Aquatic Conservation Strategy objectives by protecting riparian habitat and by providing for better long-term growth and persistence of functioning vegetation communities in Riparian Reserves, while reducing the risk of high erosion rates that result from widespread high intensity wildfires, allowing for unplanned ignitions to play their natural role in the ecosystem.

Human Uses

Core Questions

1. What are the causes of change between historical and current human uses?
2. What are the influences and relationships between human uses and other ecosystem processes in the watershed?

Heritage

Present Condition

- There are at least twenty-four known cultural resources (sites) within or very near the Squaw Valley Creek Watershed boundary, and there are likely additional resources that have not yet been identified.
- Some of the sites within the watershed have been susceptible to damage and destruction from human uses and other ecosystem processes inside the watershed.
- The current condition of most of the sites inside the watershed is not known since they have not been visited or assessed for impacts since their original documentation, which varies from 1978-1990.

Causal Mechanism(s)

- Surveys for cultural resources inside the watershed analysis area have previously been limited causing large areas within the analysis boundary to remain unsurveyed.
- Most of the sites have not been formally visited or monitored since their original documentation.
- Site records indicate that sites located on or near roads and trails have been more susceptible to damage and destruction from users of those routes, including vandalism from looting and impacts from modern camping.
- Creek erosion, weathering, road construction, and logging have also been identified as causing damage to some of the sites.

Trends

- Natural erosion, weathering, fire activity, casual recreation, road building, and road reconstruction will continue to impact sites over time.

Influences and Relationships

- Continued or improved recreational access to the watershed will increase negative impacts to cultural resources, including historic trails and prehistoric and historic campsites.
- Management activities such as logging and road construction have the potential to disturb or destroy known and unknown cultural resources.

Conclusions

- Adequate survey for cultural resources within the entire watershed boundary should be conducted to ensure an accurate inventory and to document previously unknown sites.

- Sites that are mapped but not formally recorded should be documented before they erode or are damaged further.
- All sites should be formally visited to update the site records and document impacts that may have occurred since the sites were originally recorded

Recreation

Present Condition

- As large areas with dense vegetation and fuel loading conducive to large fire growth and extreme fire behavior increase in the analysis area, the risk of adverse effects to recreation resources (e.g., scenery and access) also increases.
- Recreation activities and other human uses in the watershed pose risks to other resources and increase the risk of human-caused fire starts.

Causal Mechanism(s)

- Past road and trail construction opened the watershed to increased recreational use.
- The most recent wildfires have affected the watershed's visual resources.
- Unauthorized OHV routes expose upland areas to direct and indirect resource impacts. Current closure orders have not eliminated this concern.
- Human settlement in the area caused effects from mining, grazing, wildfire suppression, timber harvest, and road construction activities.

Trends

- OHV and pedestrian traffic are expected to increase.
- Recreation use in the watershed is expected to increase the potential for human-caused fire starts.

Influences and Relationships

- Increased OHV traffic has the potential to impact the integrity of the watershed by creating new routes on the landscape, creating ruts that channel water downslope, impacting soil, and spreading noxious weeds. In addition, if unauthorized routes increased, particularly in sparsely covered landscapes, can adversely affect the forest's visual resources and rare plant populations and habitat.
- Recreation use increases the likelihood of human-ignited fires. Runaway campfires, fireworks, and ignition from OHVs have the potential to create conditions for high-severity fire. Human caused fire starts along streams at the base of slopes may result in hotter and more damaging fires than fire starts along ridgetops. Major wildfires have the potential to affect access to and the quality of recreational activities.
- Recreation and other human uses within the watershed may increase the potential for unplanned fires. Conversely, smoke from large fires that does not disperse has the potential to negatively impact the recreation experience in the watershed.

- Widespread high intensity wildfires may burn large areas of vegetation, thus potentially exposing caves to increased exploration and resource damage; major wildfires also impact visual resources.
- Impacts to air quality from major wildfires are of concern for their effect on human uses. Prescribed fires may also impact air quality; however, these impacts are managed to reduce adverse effects.

Conclusions

- Increased recreational use of the watershed may increase soil erosion, human-caused fire starts, and noxious weeds infestations, thereby adversely affecting water quality, heritage, visual resources, rare plant populations and habitat, and special features such as caves.
- Major wildfires have the potential for adverse impacts to recreation, visual resources and other human uses in the watershed. As the risk of major wildfires increases with continued fuels accumulation, the risk of impacts to human uses from fires also increases.

Chapter 6: Recommendations

The purpose of this step is to bring the results of the previous steps to conclusion, focusing on management recommendations that are responsive to watershed processes identified in the analysis. By documenting logical flow through the analysis, issues and key questions (from step 2) are linked with step 5 synthesis and interpretation of ecosystem understandings (from steps 1, 3, and 4). Monitoring activities are identified that are responsive to the issues and key questions. Data gaps and limitations of the analysis are also documented.

Recommendations included in this chapter are:

- Fire and Fuels Management
- Habitat Quality Management
- Late Successional Reserve
- Access
- Riparian Reserves
- Research Needs
- Survey, Inventory, Monitoring Needs
- Other Management/Restoration

Fire and Fuels Management

Recommendations

- Fire management activities including hand/mechanical fuel reduction treatments, the use of prescribed fire and utilizing unplanned fires for resource benefit are needed to:
    - reduce fire effects and fire behavior in the analysis area,
    - to meet land management objectives,
    - to restore fire processes where compatible with other resource needs
- Fuel reduction treatments should focus on areas where high resource values are subject to high hazard and high risk. The future outcome would be a return of fire to the forest ecosystem which would be achieved by limiting intensity of fire that occurs in the area by reducing fuels, reintroducing fire into the ecosystem, and restoring the ecosystem to a pre-suppression condition in which fire would be consistent with low/moderate-intensity fires that were common historically whether the ignitions are planned or unplanned
- Employ a collaborative landscape approach with adjacent landowners and agencies to reduce fire hazard and fire risk to values identified in the analysis area. The majority of this approach would be prescribed burning and managing unplanned fire for resource benefit; however, thinning, mechanical treatments, and other fuels and vegetation treatments may be considered. Focus on fuel reduction treatments that alter the fuel profile so that it is consistent with policy and land management direction and more closely resembling historic conditions.
- Use natural and management created fuel-breaks in future wildfire suppression and fuels treatment activities in the analysis area. These fuel-breaks can be maintained and used with little additional investment and will increase the safety and effectiveness of fire management activities.
- Ensure there is access during fire season and periods of project implementation. Ensure roads and infrastructures (i.e. bridges) are accessible for necessary fire equipment (i.e. fire engines, crew hauls, dozers, etc.).
- Encourage all residents within and adjacent to the analysis area to use defensible space precautions around their homes.
- Manage vegetation to reduce the potential for adverse impacts to air quality, and all resources, from future wildfires. Maintain air quality values to meet or exceed applicable standards and regulations during fuel reduction treatment activities.
- Incorporate lessons learned from past fires and land management actions into future vegetation, fuels, and fire management planning.

Habitat Quality

Recommendations

- Utilize active management tools such as prescribed fire to improve habitat quality.

- Consider physiographic (e.g. soils, slope, aspect, elevation) as well as biotic (e.g. species composition, stand structure) features when predicting habitat quality outcomes from prescribed fire or other vegetation management activities. Plant communities are largely controlled by site quality and vegetation response differs by physiographic conditions.

Late-Successional Reserve

Recommendations

- Prepare the watershed for the reintroduction of fire while targeting the ultimate outcome of restoring forest ecosystems that are both: 1) resistant to high severity fire and 2) will provide optimal habitat conditions for species associated with late seral stage conditions.
- Due to the increased level of importance placed on the Critical Habitat Unit within which the Squaw Valley Creek Watershed occurs, management should focus on activities that are compatible with the objectives of enhancement, protection, and promotion of the high value habitat present within the watershed analysis area.

Access

Recommendations

- Ensure there is access during fire season and periods of project implementation. Ensure roads, trails, and infrastructures (i.e. bridges) are accessible for necessary management equipment (e.g. fire engines, crew hauls, OHVs, dozers, etc.).
- The potential for constructing new hiking and OHV trails in the watershed should be assessed.
- Reopen, upgrade, and maintain existing trails in the watershed analysis area (e.g. Tom Dow and Tom Neil).
- Consider the addition of an OHV trail extending from the end of the Bald Mountain Jeep Trail along the ridge to the vicinity of Muleshoe in Squaw Valley Creek Canyon for fuel reduction (non-recreational) purposes.
- Collaborate with private landowners within the watershed analysis area to create viable access options for public agencies.
- Implement the standards and guidelines in the new Travel Management Plan (USDA Forest Service 2009) once that plan is finalized.
- Re-asses the Eastside Road Recommendations developed from the USDA Forest Service 2002 Roads Analysis Report, for all roads within the watershed analysis area.

Riparian Reserves

Recommendations

- Use the existing Riparian Reserve widths as delineated in the Shasta-Trinity corporate geodatabase (and originally the Forest Plan) unless wider widths are specified by a hydrologist or geologist on a site-specific basis.
- The following resource activities are considered acceptable within Riparian Reserves when designed to meet the objectives of the Aquatic Conservation Strategy:
    - Timber harvest to reduce fuel loads
    - Slashing and hand piling/burning of natural and activity fuels
    - Prescribed burning
    - Planting of conifers and other native species in valleys of private lands
- Use low-intensity prescribed fires in within Riparian Reserves.
- Apply prescribed fire with an objective of retaining 60% duff and ground cover.
- Consider consolidating unstable areas and leaving larger areas unburned if management objectives for prescribed fire can still be met.
- Include resources specialists (e.g. hydrologist, geologist, silviculturist) in the design process for all prescribed burning projects in this watershed.
- Use existing trails in Riparian Reserves and on private riparian lands (with owner permission) for management access and fuel breaks.

Research, Survey, and Monitoring Needs

Recommendations

- Research, surveys, and monitoring should be conducted whenever feasible in order to:
    - Inform sound management decisions, and to
    - Increase opportunities for implementing projects without undue restraint

Vegetation, Fire and Fuels

- Attempts to engage intra-government and academic research entities to identify and conduct studies evaluating the interaction of fire on particular species (see Species and Habitat section Chapter 3) would aid land managers' abilities to conduct fuel reduction treatments and restore the role of fire to the landscape.
- Develop a monitoring strategy for the analysis area that is inclusive of vegetation and fire management goals and is flexible, quantitative and integrated with other disciplines to allow for a comprehensive approach to managing the analysis area.

Cave Resources

- Identify locations of caves and abandoned mines within the analysis area.

- Consult with local Grottos associated with the National Speleological Society on the locations and mapped extents of known caves, and develop site specific mitigations as needed to address cave resources.
- Conduct reconnaissance level field inventories of karst areas prior to implementing ground and vegetation disturbing activities.
- Use low-intensity prescribed fires in the vicinity of cave entrances. Pre-treat fuels when necessary, by removing from the site by hand or other prescriptive means.

Geology/Soils

- Identify all known unstable lands and incorporate this information into vegetation management and burn plans. Assure that high severity fire is avoided in these areas, and prescriptive level input from a qualified resource specialist is obtained on a site specific basis.

Human Uses

- Conduct survey within the watershed boundary to inventory and document all cultural resources possible.
- Monitor documented sites to assess the current conditions and update the site records.

Rare Plants and Noxious Weeds

- Explore opportunities to conduct studies on rare plant and noxious weeds within the watershed, particularly in response to vegetation management and fuels treatments.
- Update this watershed analysis with new information gleaned from surveys or monitoring regarding the location, abundance, or occurrences of species of concern.

Wildlife

- Re-establish and expand past northern spotted owl surveys in an effort to determine to what extent the barred owl has impacted the area and whether known NSO activity centers have been affected.
- Data on the caves in the watershed is incomplete in so far as a comprehensive and current account of what species of bat use the caves and the role the caves play in the bats' lifecycle
- Data are also needed to determine to what extent these caves are being used by recreational cavers and what precautions are necessary to protect against the spread of WNS.
- Site-specific and species specific surveys for federally listed or candidate species and Forest Service Sensitive species and their potential habitats are needed within the watershed in order to assess priorities for management actions or protections.
    - Examples of such surveys are:
        - Willow flycatcher surveys on the large patches of willows in the north and central portions of the watershed, potentially in collaboration with

the private land owners that also have suitable willow habitat. Some older survey information exists in the forest databases, but no current presence/absence or abundance and distribution information is available.

  - Amphibian surveys within Squaw Valley Creek and its tributaries
  - Shasta salamander surveys in the limestone outcroppings
  - Goshawk surveys in suitable mid and late seral habitat

- Conduct aquatic mollusk surveys, particularly near springs and seeps that may be impacted by erosion or management actions.
- There is a need to investigate Dry Lake and the surrounding area for its role as a potential vernal pool, and describe whether it is habitat for the federally threatened vernal pool fairy shrimp and perform subsequent surveys if it is determined to be suitable.
- There is a need to map additional limestone habitats that have had only anecdotal location information.

Other Management/Restoration

See Project file for further information.

Recommendations

Heritage

- Stabilize the creek banks associated with the erosion of cultural resources.
- Protect cultural sites against negative effects by limiting public use through the installation of barriers at pullouts and by posting "No Camping" signs at historic and prehistoric campsites that are attractive to modern campers.
- Install interpretive signs for public education at historic trailheads.

Rare Plants and Noxious Weeds

- Conduct a rare plant survey of the analysis area, including limestone outcrops.
- Develop a weed management plan for the watershed (including an implementation schedule).
- Identify possible treatment areas and methods for noxious weed species control or eradication.

Watershed Restoration

- Focus road maintenance efforts on high sediment yielding road situations, particularly in relation to existing RAP and TAP analyses' results.
- Consider road surfacing and/or reshaping (outsloping and dipping the surface where safe) on high use or overly steep sections of road.
- Implement restoration projects in the watershed as opportunities arise.

Appendix A – Glossary

The following terms are taken from Schwarz et al. 1976, Merriam Webster Dictionary (http://www.merriam-webster.com/), or the Oregon Department of Fish and Wildlife.

Abiotic: The nonliving, material (as opposed to conceptual) components of the environment such as air, rocks, soil (in general), water, coal, peat, plant litter, etc.

Airshed: 1. A region with common sources and problems of air pollution; it may coincide with a watershed or be a part of a large urban agglomeration. 2. The air encompassing a specific geographic region.

Alluvial: Pertaining to material that is transported and deposited by running water.

Anadromous fish: Those species of fish that are born and rear in freshwater streams and estuaries mature in the ocean, and migrate back to freshwater streams to spawn. Salmon, steelhead, and shad are examples.

Aspect: The compass direction that the slope of a land surface faces toward (e.g. north, northwest, south).

Background: The distant part of a scene, landscape, etc.

Bedrock: 1. The more or less solid rock either on or beneath the surface of the earth. It may be soft or hard and have a smooth or irregular surface. 2. Any in place, solid rock exposed at the surface of the earth or overlain by unconsolidated material.

Biomass: The total quantity (at a given time) of living organisms of one or more species per unit of space (species biomass), or of all the species in a biotic community (community biomass).

Biota: The plants and animals of an area, taken collectively.

Biotic: All the natural living organisms in a planning area and their life processes. The term "biotic" in land use planning contexts is most commonly used as a resource classification category which subdivides the natural resources and properties into either the biota and living characteristics or the abiotic (non-living) entities and characteristics.

Blowdown: Also called "windthrow". Generally used when referring to trees uprooted by the wind.

Browse: That part of the current leaf and twig growth of shrubs, woody vines and trees available for animal consumption.

Brush: 1. A growth of shrubs or small trees usually of a type undesirable to livestock or timber management. 2. A collective term that refers to stands of vegetation dominated by shrubby, woody plants or low growing trees – regardless of whether some of the components are cropped.

Bulk density: The mass or weight of oven-dry soil per unit of bulk volume, including air space.

Carnivore: An organism (plant or animal) that feeds on animal substances.

Carrion: The bodies of dead animals, usually found in nature in the process of decay; not "fresh meat".

Clearcutting: 1. Removal of virtually all of the trees, large or small, in a stand in one cutting operation. 2. The term "clearcutting" is also loosely applied to any type of cutting in which all the merchantable timber is cut and all trees that cannot be utilized profitably are left.

Climax vegetation: 1.The group of plant species which is the culminating stage in plant succession for a given set of environmental conditions. 2. A relatively stable type of vegetation in equilibrium with its environment and with good self perpetuating reproduction of the dominant plant species.

Colluvium: Mixed deposits of soil material and rock fragments accumulated near the base of steep slopes through soil creep, landslides, and local surface runoff.

Crown: The upper part of a tree or other woody plant carrying the main branch system and foliage above a more or less clean stem(s).

Cubic feet per second (c.f.s. or ft^3/s): The amount of water, measured in cubic feet, which flows by a point in a channel (or is discharged from a discharge point).

Diameter at breast height (DBH): The diameter of a tree measured four feet, six inches from the ground level. "Ground level" can follow two conventions; either the highest point of the ground touching the stem, or the mean of the highest and lowest points.

Dissolved oxygen: 1. The oxygen dissolved and freely available in water. 2. The oxygen dissolved in water, waste water, or other liquid and usually expressed in milligrams per liter, parts per million, or percent of saturation.

Dissolved Organic Carbon (DOC): The thousands of dissolved compounds found in water that derives from organic materials (such as decomposed plant matter).

Edge habitats: The transition zone between two different habitat types.

Endangered species: 1. An endangered species, or subspecies, of animal or plant is one whose prospects of survival and reproduction are in immediate jeopardy. 2. Any species which is in danger of extinction throughout all or a significant portion of its range.

Endemic species: A species whose natural occurrence is confined to a certain region and whose distribution s relatively limited.

Fauna: The animal life of an area, "animal" being used in a broad sense to include birds, fish, reptiles, insects, mollusks, crustaceans, etc., in addition to mammals.

Fire Hazard: A characterization of how a fire will burn (e.g. fire behavior)

Fire Risk: The probability of a fire start occurring over a specific time period over a specific area.

Flora: 1. The plant life of an area. 2. The sum total of the kinds of plants in an area at one time.

Fluvial: 1. Of or pertaining to streams and flowing waters. 2. Growing or living in streams. 3. Produced by stream action, as a fluvial plain.

Forage: All browse and nonwoody plants that are available to livestock or game animals and used for grazing or harvested for feeding.

Forb: Any herbaceous plant other than true grasses, sedges, and rushes. Also may be any non grass like plant having little or no woody material on it.

Foreground: That part of a scene, landscape, etc. which is nearest to the viewer.

Fuel-break: A natural or artificial barrier usually created by the removal of vegetation and used to prevent or retard the spread of fire. Also may be called a "fire break".

Game species: Any species of wildlife for which seasons and bag limits have been prescribed, and which are normally restricted to possession by sportspersons under state laws and regulations.

Geomorphology: A science that deals with the relief features of the earth or of another celestial body (as the moon) and seeks a genetic interpretation of them.

Groundwater: Water within the earth that supplies wells and springs. Specifically, water in the zone of saturation where all openings in soils and rocks are filled – the upper surface of which forms the water table.

Heterogeneous: Differing in kind; having qualities which are significantly not uniform throughout; possessed of different characteristics; opposed to homogeneous.

Homogeneous: Of the same kind or nature; consisting of similar parts or of elements of a like nature; having qualities which are significantly uniform throughout; opposed to heterogeneous.

Hydrologic Unit system: A standardized watershed classification system developed by USGS in the mid 1970s. Hydrologic Unit Codes (HUCs) describe the various scales of the units. On the Shasta-Trinity NF these are delineated into eight levels (ranging from largest to smallest): Region, Subregion, Basin, Subbasin, Watershed, Subwatershed, Drainage, and Subdrainage.

Karst: A terrain with distinctive landforms and hydrology created from the dissolution of soluble rocks, principally limestone and dolomite.

Mass wasting: A general term for any of the variety of processes by which large masses of earth material are moved downslope by gravitational forces – either slowly or quickly.

Mesic: Refers to environmental conditions that have medium moisture supplies rather than hydric (wet) or xeric (dry) conditions.

Microclimate: The essentially uniform local climate of a usually small site or habitat.

Mineral soil: A soil consisting predominantly of, and having its properties determined predominantly by inorganic matter. Usually contains less than 20 percent organic matter.

Noxious plants: Also known as "noxious weeds" or "invasive plants". Typically non-native plants that have been introduced into an area without the insect predators or plant pathogens that help keep them in check in their native habitats.

Peak flow: The maximum volume of flow attained at a given point in a stream during a runoff event. Also known as "peak discharge".

Percolation: The downward movement of water within soil, especially the downward flow of water in saturated or nearly saturated soil.

Perennial stream: Streams that flow throughout the year and from source to mouth.

Polycyclic hydrocarbons: Any of a class of hydrocarbon molecules that have multiple carbon rings, and that include carcinogenic substances and environmental pollutants.

Prescribed burn: The planned burning of a forest, stand, prairie, or slash pile with the intent to confine the burning to a predetermined area.

Riparian: 1. In loose usage, referring to the land bordering a stream, lake or tidewater. 2. Of, pertaining to, or situated on the banks of a river (though by common usage extended to include any stream, irrespective of size).

Runoff: 1. The total stream discharge of water, including both surface and subsurface flow, usually expressed in acre feet.

Sensitive species: Generally refers to any naturally-reproducing fish, wildlife or plant species which are facing one or more threats to their populations and/or habitats. Implementation of appropriate conservation measures to address the threats may prevent them from declining to the point of qualifying for threatened or endangered status.

Seral: A biotic community which is developmental, transitory stage in an ecologic succession.

Silviculture: Generally, the science and art of cultivating (i.e. growing and tending) forest crops, based on knowledge of silvics (growth and development of trees).

Slash: The residue left on the ground after timber cutting and/or accumulating there as a result of storm, fire or other damage. It includes unutilized logs, uprooted stumps, broken or uprooted stems, branches, twigs, leaves, bark and chips.

Snag: 1. A standing dead tree from which the leaves and most of the branches have falled. 2. A standing section of the stem of a tree broken off at a height of 20 or more feet above the ground.

Stand: An aggregation of trees or other growth occupying a specific area and sufficiently uniform in composition (species), age arrangement, and condition as to be distinguishable from the forest or other growth on adjoining areas.

Succession: 1. An orderly process of biotic community development that involves changes in species, structure and community processes with time; it is reasonably directional and, therefore, predictable.

Surface erosion: Erosion which removes materials from the surface of the land as distinguished from gully or channel erosion. The two main types of surface erosion are sheet erosion and rill erosion.

Suspended particulate matter: Sum of all microscopic solid and liquid particles, of human and natural origin, that remain suspended in a medium such as air for some time. These particles vary greatly in size, composition, and origin, and may be harmful.

Swale: A low-lying or depressed and often wet stretch of land.

Threatened species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and which has been designated in the Federal Register by the Secretary of Interior as a threatened species. This includes species categorized as rare, very rare, or depleted.

Topography: The configuration of a surface including a relief, elevation and the position of its natural and man-made features.

Turbidity: Defined as the capacity of materials suspended in water to scatter light. It is measured in arbitrary Jackson turbidity units (JTU). Highly turbid water is often called "muddy", although all manner of suspended particles contribute to turbidity.

Watershed: The total area above a given point on a stream that contributes water to the flow at that point.

Wildfire: A free-burning fire. Any fire other than a controlled burn or a prescribed burn, occurring on wildland.

Wildland Urban Interface (WUI): The area where houses or dwellings meet or intermingle with undeveloped wildland vegetation.

Xeric: Refers to a habitat characterized by dry conditions rather than mesic (moderate)

Appendix B – References

Note: The following references are cited within the main document. For further references used, but not cited, refer to the project file.

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Appendix C – Map List

***Maps available in a separate package.**

Map 1: Vicinity

Map 2: Hydrologic Units

Map 3: Land Ownership

Map 4: McCloud River Subbasin

Map 5: Bedrock

Map 6: Limestone Bearing Rock Units

Map 7: Dominant Physical Features

Map 8: Percent Slope

Map 9: Geomorphology

Map 10: Soils

Map 11: Coordinated Resource Management Plan Extent

Map 12: Coordinated Resource Management Plan - WSR

Map 13: Vegetation Aerial Imagery

Map 14: Vegetation

Map 15: Fire History by Decade

Map 16: Late Successional Conifer Habitat

Map 17: Late Successional Reserve and Roadless Area

Map 18: Riparian Reserves

Map 19: Northern Spotted Owl Critical Habitat Unit

Map 20: Stream Types and Fish Presence

Map 21: Recreation

Map 22: Transportation

Map 23: Wildland Urban Interface

Map 24: LRMP Land Allocation

Map 25: Administrative Boundaries

Map 26: LRMP Prescription